ANALYSIS OF THE PERCEPTION AND MANAGEMENT OF RISK IN THE DELIVERY OF MAJOR ROAD PROJECTS: A CASE STUDY OF THE HIGHWAYS AGENCY

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Do not remember the former things,

Nor consider the things of old.

Behold I will do a new thing,

Now it shall spring forth;

Shall you not know it?

I will even make a ***road*** *in the*

wilderness

And rivers in the desert.

Isaiah 43:18-19

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I remember

Gbeminiyi Sobanjo: mentor, friend and brother ... his life was gentle

Abstract

The major roads programme of the Highways Agency (HA) has been the subject of recent reviews. The first review by the National Audit Office examined how the agency estimates and monitors costs, and observed that there were significant risks in its processes. The second review by the Nichols Group observed that the agency aspires to best practice in risk management but its present approach is largely ineffective. Risk management often fails to meet expectations as risk is managed by individuals or groups and the human element introduces complexity into the process. If attitudes to risk can be assessed with some degree of accuracy, the sources of bias can be diagnosed and their influence on the risk process exposed. The perception and management of project risk in the agency has been analysed using data on 45 completed major road projects and interviews/discussions with some key people involved in risk management. The study found that the number of projects overrunning their estimate was almost the same as projects with underruns. Mean performance statistics are therefore not a reliable guide for the overall outturn of projects. The study has attempted to classify the agency as having a *Risk Tolerance* profile as opposed to the classic academic view that public organisations are very risk averse. The study concludes that in order for the HA to realise the potential benefits of its change programme it should consider some identified institutional factors alongside the review of its processes and procedures.

Keywords: *Perception, Risk Attitude, Risk Management, Creep, Organisational Learning*

Word Count: *11,324*

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List of Abbreviations

DB	Design and Build
DBFO	Design Build Finance Operate
DfT	Department for Transport
ECI	Early Contractor Involvement
HA	Highways Agency
MAB	Ministerial Approved Budget
NAO	National Audit Office
OGC	Office of Government Commerce
PEC	Adjusted TPI Entry Cost
TPI	Targeted Programme of Improvements

Chapter One Introduction

1.1 Background to the Study

In recent years the construction industry in the United Kingdom has been the subject of major reviews. All of the reviews have recommended that the industry needs to improve its performance. In 1994 Sir Michael Latham reviewed the procurement of consultants and contractors, and contractual arrangements. He observed that while some of the recommendations of previous reports had been implemented, and the industry had changed considerably, some problems remained and he recommended structures to tackle them. (Latham, 1994:3).

Sir John Egan in 1998 set targets for improvements in capital cost, construction time, predictability, defects, accidents, productivity, turnover and profits and he recommended key drivers to bring about these improvements. One of the drivers was that construction should be undertaken by integrated teams so as to mitigate fragmentation and the attendant adversarial relationships that characterised the industry. (Office of the Deputy Prime Minister, 1998).

Both reviews have resulted in a major departure from the use of traditional procurement. In the public sector, the Office of Government Commerce (OGC) has recommended that traditional procurement should only be used if a department or agency could demonstrate that its use would provide better value for money than any of the other prescribed procurement routes (OGC, 2003:5). Public sector clients have thus been presented with innovative procurement routes that require greater levels of engagement with integrated project teams.

The Highways Agency (HA) is an executive agency of the Department for Transport (DfT), and is responsible for operating, maintaining and improving the strategic road network in England (see Fig 1.1). Founded in 1994, it has a total asset value of £82billion, 99.0% of which relate to the trunk road infrastructure. As at 1 October 2004 the length of the network was 7,754km. Its voted budget for 2006-2007 was £6.259billion. (Source:http://www.highways.gov.uk accessed 27 September 2007).

Following public reaction to the environmental impacts of road construction the government reviewed its roads programme and in 1998 published a *New Deal for Trunk Roads in England* which made trunk road maintenance a first priority.

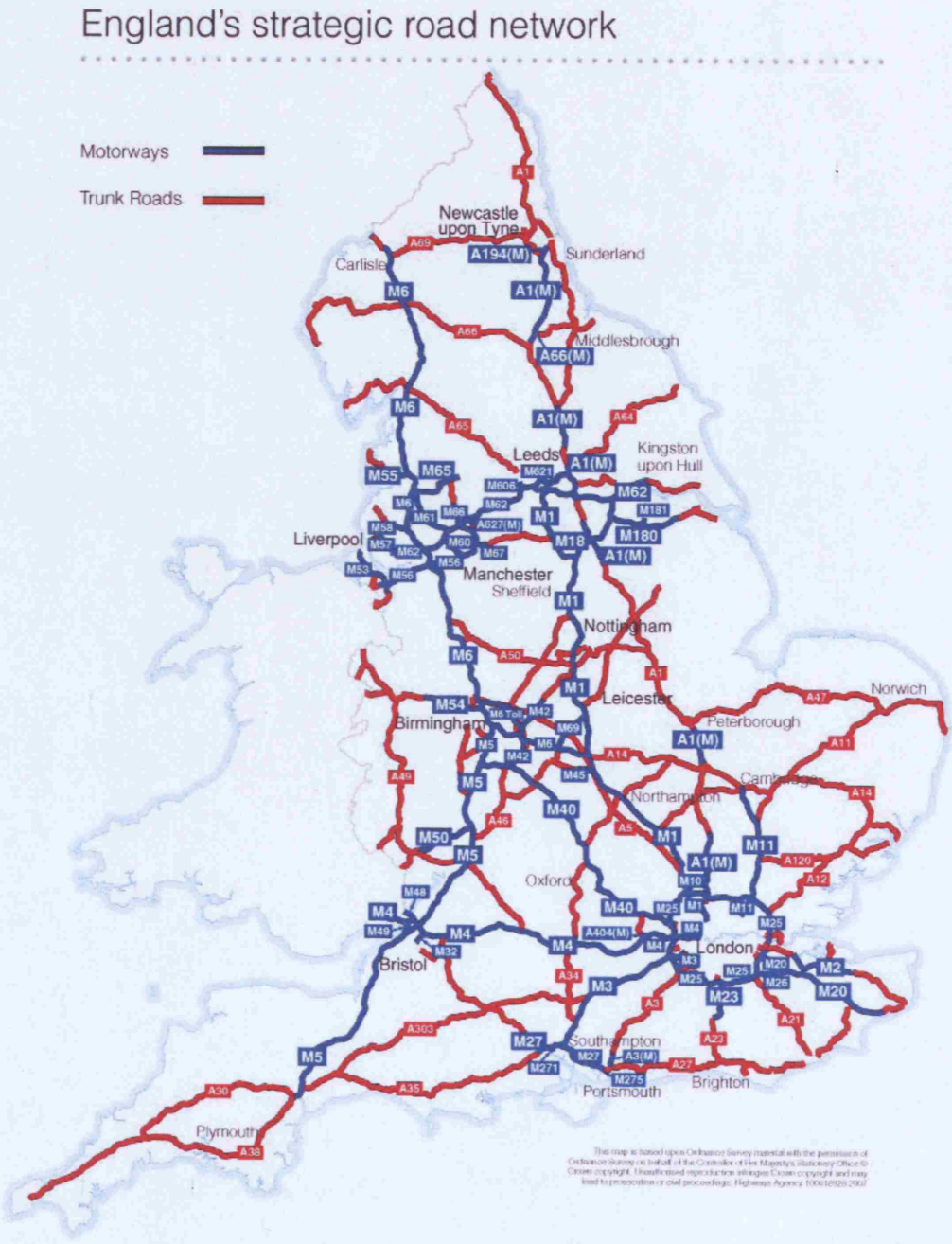


Fig 1.1 Strategic Road Network in England (Source:http://www.highways.gov.uk /aboutus/documents/AnnualReport2006-07.pdf accessed 27 September 2007)

A New Deal for Trunk Roads also established the Targeted Programme for Improvements (TPI) in the Major Projects directorate of the HA. The TPI was aimed at tackling the most serious congestion problems though targeted improvements. It consists of a total of 113 schemes of which eight schemes have been remitted, transferred or are being reviewed, 45 schemes have been completed, leaving 60 active schemes. For a scheme to be included in the TPI, it would have been identified and appraised as a transport investment proposal by the Department for Transport. Each scheme is progressed through four broad stages which include Study, Planning, Construction and Post Opening.

Originally the HA employed traditional Institution of Civil Engineering (ICE) contracts to procure road projects. It moved away after some adverse experiences to try partnering arrangements and procurement routes in order to mitigate fragmentation and adversarial relationships which characterise construction. It has tried Design Build Finance and Operate (DBFO), and Design and Build (DB) before adopting Early Contractor Involvement (ECI) as its preferred procurement method. All three forms of procurement still have a place in HA policy, but ECI is now the preferred method of contracting. This is a form of partnering with the contractor who is appointed earlier than usual to help in planning, to give advice on 'buildability', and jointly develop a target price as the basis for a pain/gain share in the contract.

In 2007, two independent reports were published about the activities of the HA. The first report by the National Audit Office (NAO) examined the processes by which the HA estimates and monitors the costs of building and improving roads. It observed that there were significant cost risks in these processes, however DfT and HA were taking steps to improve monitoring, cost control, and the development of procurement strategy.

The second review was chaired by Mike Nichols of the Nichols Group. It followed a series of increases in estimates by up to 300% on TPI schemes for which construction had not begun. Nichols reviewed the nature of the roads programme, governance structures, and the capability of the HA in estimating, risk management, procurement, and delivery. Among other issues, Nichols reported that though the HA aspires to best practice in risk management, its present approach falls short of that goal and is largely ineffective. Risk assessments were found to be optimistic and unreliable not because risk events occurred but because of limited understanding of their scope and the fact that standard provisions being made for risk were inappropriate. Both reviews made recommendations to the HA and DfT on how to improve governance structures, competencies and capabilities.

1.2 Aim of the Study

The aim of this study is to analyse the perception and management of risk in the delivery of major road projects in the United Kingdom, by using the Targeted Programme of Improvements of the Major Projects Directorate of the HA as a case study. Based on the findings of the study, recommendations are made to the HA to complement the prescriptions by previous reviews to improve project risk management in the agency.

1.3 Objectives of the Study

The objectives to realise this aim are as follow:

- Review of the existing literature on perception psychology and risk management in order to develop a conceptual framework for the study
- Gathering of available data on completed TPI road projects
- Analyses of the gathered data
- Gathering of data on the human side of risk management through interviews and discussions with client project managers and key staff of the Highways Agency
- Review of the findings of the interviews and discussions
- Making recommendations to the HA based on the findings of the study

1.4 Selection of the Case Study

Although there are a number of road programmes within the Major Projects directorate, this study has only considered completed TPI projects. The intention is to take advantage of similarities in the processes by which the schemes are progressed from inception, through planning, to procurement and delivery, and thereby draw meaningful conclusions about attitudes to project risk within the HA. Only completed road projects have been analysed as ongoing schemes remain subject to scope changes.

1.5 The structure of the Report

This study consists of six chapters: Chapter One provides a background to the study. In Chapter Two, a conceptual framework for the study is developed from a review of existing literature on perception psychology and risk management. Chapter Three is a description of the methodology to be applied throughout the study. Justification is provided for the methods adopted throughout the study. In Chapter four, data which have been gathered on 45 completed TPI schemes, and findings from interviews with HA project managers and key staff are presented and analysed. Chapter Five is a detailed discussion of the analyses performed in the previous chapter. The study concludes in Chapter 6 with some recommendations to the Highways Agency and suggestions for future research.

Chapter Two Conceptual Framework

2.1 Introduction

The focus of this chapter is to develop a conceptual framework to be employed to analyse the perception and management of risk within the Major Projects directorate of the HA, through a review of relevant literature in perception psychology and risk management.

2.2 Research Propositions

Risk management is recognized as an essential contributor to business and project success. However, it often fails to meet expectations as evidenced by the continued history of business and project failures. The mere existence of principles, well-defined processes, and widespread practice does not guarantee success. Risk is managed by people acting individually or in groups and the human element introduces an additional element of complexity into the process. If attitudes to risk can be assessed with some degree of accuracy, the sources of bias can be diagnosed and their influence on the risk process exposed. (Hillson et al, 2007: xvii).

The TPI is not a programme of projects but was developed to be a central focus for combating the most pressing road infrastructure problems. Projects are managed by 14 area teams that cover the whole of England. Individually managed projects would not benefit from the advantages of programme management such as improved communication, improved resource management, better project prioritisation, and better management of risk across interrelated projects. The overall performance of projects would also be influenced by individual project peculiarities such as location, type of scheme, project size, type of procurement, actual resources deployed and duration.

2.3 Uncertainty and Risk

Uncertainty is the difference between the information required for a decision and the information that is available. (Galbraith 1977, cited in Winch, 2002:6). Two main sources of uncertainty are:

- Complexity (the information is available but it is difficult to collect and analyse)
- Predictability (the past is not a reliable guide to the future)

At the inception of a construction project, uncertainty is very high. It depends on the extent to which the asset to be constructed is a copy of existing assets, the extent to which standardised components and solutions can be used, and the extent of the requirement for new technology. This uncertainty is inherent in the project and has been

described as mission uncertainty. There is a progressive reduction of uncertainty as more information becomes available. The level of uncertainty at a particular point in the project life cycle relative to earlier points has been described as dynamic uncertainty. At completion all the information required for the project is available and is embodied in the built asset. (Winch, 2002:7).

Risk is the condition where information is still missing but a probability can be assigned to the occurrence of an event about which a decision is to be taken. In strict statistical term risk refers to the expected events where the outcome is either to the benefit or detriment of the decision maker. The common usage of risk however is the probability of a detrimental event while reward is used to describe the probability of a beneficial event. (Winch, 2002:316).

Risk analysis tools are not readily applicable to construction projects as they rely heavily on existing data. Project risk is therefore managed intuitively based on such factors as the proportion of total assets at stake, sentiment, laws of chance, organisational culture, and managerial capabilities of project managers. Many construction clients are within the public sector and are believed to be typically very risk averse. (Winch, 2002:318-19).

Cost overruns are widespread in major transportation projects. Overruns threaten the viability of projects. A first step in reducing cost overruns is to acknowledge that a substantial risk of overruns exists which can be moderated but not completely excluded. A next step is to allocate the risk of overrun to those best able to manage it. (Flyvberg et al, 2003:11-12).

Project stakeholders face different risk profiles when they analyse risk on a project and a pertinent question to ask is 'whose risk?' There are four basic attitudes or responses to a given level of risk and these are illustrated in Table 2.1 (Hillson et al, 2007:43-45).

Decision-makers may benefit from rewards and they may bear losses from risks, or bear the costs associated with risks while others benefit from the rewards. In a client's organisation, it is the managers of the core operational business who reap the rewards and risks associated with the income stream. The project management team face the risk associated with a rising outturn price but their reward from negative variations is very limited. This creates tension between different functions within the client's organisation. Senior management may override decisions taken by the project management team thereby generating variations. They may also be reluctant to freeze design at the time defined in the project programme. (Manseau et al 2001, cited in Winch, 2002:321). Promoters of the project face the risk of the project being cancelled while those funding

the project face the risk of the project not being cancelled even when things start to go wrong. (Winch, 2002:321).

Table 2.1 Basic Risk Attitudes

No.	Risk Attitude	Description
1	Risk Aversion	Uncomfortable with uncertainty, low tolerance for ambiguity, seeks security and resolution Practical, accepting, with common sense, enjoys facts more than theories, supports established methods of working Tends to over-react to threats and under-react to opportunities
2	Risk Tolerance	Reasonably comfortable with most uncertainty Accepts uncertainty as a normal feature of everyday life Uncertainty has no significant influence on behaviour May fail to appreciate the potential effect of risk on the achievement of objectives
3	Risk Neutrality	Sees risk as a price worth paying for future pay-offs Seeks strategies and tactics that have high future pay-offs Envisage possibilities Focuses on the longer term
4	Risk Seeking	Casual approach towards risk Sensitive to opportunities The thrill of the chase can outweigh the potential for harm Threats are underestimated in probability and impact

2.4 Probability Elicitation

Most of the sophisticated techniques for risk identification and analysis rely on quantitative methods. They require reliable data sets from previous projects which are often not available. Methods have been therefore been developed to extract subjective probabilities from subject matter experts. This remains contentious and there is considerable experimental evidence to show that experts sometimes assign inaccurate and inconsistent numbers to judgements. Those who interpret the results of such analyses may also forget that the assigned probabilities are subjective, but see them as objective measurements of the level of risk. The most widely accepted risk management methodology for eliciting subjective probabilities is the Stanford Research Institute protocol and it involves the following six steps. (Winch, 2002:326-327).

(i) Identification and selection of issues

(ii) Identification and selection of experts

(iii) Discussion and refinement of issues

(iv) Training for elicitation

(v) Elicitation through interviews

(vi) Analysis, aggregation, and resolution of disagreements

Any process for eliciting probability assessments from individuals needs to be carefully managed for it to be seen as effective and reliable. (Chapman et al, 1997:179). Often, objective data form the basis for subjective probabilities and subjective adjustments may be made to data-based estimates in order to reflect issues which are known to be important even though they may not be immediately quantifiable in objective terms. (Chapman et al, 1997:187). Sometimes, there are no data or available data may be contradictory and individual assessors may feel unwilling or unable to provide estimates of probability. They may however still provide useful information about the behaviour of the variables in question. Subjective probability distributions are not justified where the level of understanding is so low that the levels of insight to be derived are likely to be of limited use. Sometimes a parametric analysis or simple order of magnitude analysis may provide as much or more insight than probability distributions elicited from experts. (Chapman et al 1997:188). Commonly used tools by which subjective project risk probabilities may also be obtained include the following:

(i) Brainstorming

(ii) Check lists

(iii) Prompt lists

(iv) Interviews

(v) SWOT Analysis

2.5 Optimism Bias

Optimism bias is the tendency on average for a set of project costs and duration to be underestimated and/or benefits to be overestimated. It is expressed as a percentage difference between the mean estimate at appraisal and mean final outturn. (Mott Macdonald, 2002: S-1). It is a measure of the extent to which the actual mean project costs (capital and operating), project duration (time from business case to benefit delivery) and works duration (time from contract award to benefit delivery) exceed those estimated. It is also a measure of the degree by which mean benefits delivered by projects fall short of the estimated benefits. (Mott Macdonald, 2002:4). Optimism bias can be estimated as follows:

$$\text{Optimism bias} = 100 \times \frac{(\text{Actual} - \text{Estimated})}{\text{Estimated}} \%$$

By assessing levels of optimism bias in projects, the level of confidence in project estimate costs, duration and benefits can be ascertained. Confidence levels in project estimates can be raised by taking account of risks when defining the nature and scope of a project and developing strategies for their effective management. Optimism bias has been measured for different elements of large publicly procured projects in the UK. The elements include the following: (Mott Macdonald, 2002:12-13).

(i) Works duration Optimism Bias
(ii) Project Duration Optimism Bias
(iii) Capital Expenditure Optimism Bias
(iv) Operating Expenditure Optimism Bias
(v) Unitary Payments Optimism Bias and
(vi) Benefits Shortfall Optimism Bias

Average optimism bias levels were obtained for traditionally procured projects as well as PFI/PPP projects. The differences in the levels of bias were attributed to the negotiated transfer of project risks from the public sector to the private sector, the level of project requirement definition, and the length of the relationship between the contractor, the service provider and the client. Optimism bias was found to decrease through the project life cycle and bias levels for PFI/PPP projects were much lower than for traditionally procured projects.

The contributions of different project risk areas to optimism bias are expressed as a percentage of the relevant average optimism bias. In most instances, inadequate requirements and inadequate project scope definition make up the major cause of

project time and cost overruns. (Mott Macdonald, 2002:S3). Examples of project risk areas are shown in Table 2.2. (Mott Macdonald, 2002:56).

Optimism bias can be managed by introducing and using the following tools which are believed to mitigate project risk and improve delivery: (Mott Macdonald, 2002:S3).

(i) Risk management

(ii) Greater diligence at the project definition stage

(iii) Partnering

(iv) More controlled cost monitoring

(v) Value management

(vi) Application of concurrent engineering

There are no absolute criteria to define best practice in terms of project management. Processes have however been developed that have the potential to improve the delivery of projects in terms of time, cost and performance. An example is the Gateway Review Process of the Office of Government Commerce (OGC). It combines the 'gateway' approach with a governance process and is supported by comprehensive guidelines and checklists.

Table 2.2 Examples of Project Risk Groups

No	Project Risk Areas	Elements
1	Procurement	Complexity of contract structure Late contractor involvement in design Poor contractor capabilities No precedent government guidelines Occurrence of dispute and claims Ineffective transfer of information between stakeholders
2	Project Specific	Design complexity Degree of innovation Environmental impact
3	Client specific	Inadequacy of the business case Large number of stakeholders Funding availability Inexperienced project management team Poor project intelligence
4	Environment	Public relations Site characteristics Permits/Consents/Approval
5	External Influences	Political Economic Change in Legislation/Regulations Unanticipated technological advancements

2.6 Incentive Plans and Theories

Reward is the complement of risk and all decision under uncertainty is a trade-off between risk and reward. (Winch, 2002:316). Incentive contracts are an important way of motivating suppliers of services by offering reward as well as the adverse effects of risk. Where contractors are selected on the basis of price rather than quality, there is insufficient incentive for them to propose quality enhancing innovative solutions. (Morris in Pryke et al, 2006:62).

Properly designed and administered incentive plans will have positive influence on project success. Project success is variable and may be measured in terms of cost, schedule, quality, safety or any other parameter. Incentive plan benefits may be as a result of the following factors (Ibbs, 1991:158):

- The contractor's performance should be enhanced by the possibility of additional monetary reward
- The level of management attention is increased
- Both parties could assign highly qualified staff to the project
- Client's requirements need to be defined more clearly and this helps to achieve closer correspondence between the client and the contractor
- Clients are encouraged to communicate more effectively within their organisation and with their contractors
- Most incentive plans rely upon existing control systems and information, and incentives encourage a more disciplined approach to using those systems and information

Major features of incentive plans are described in Table 2.3:

Incentive, however, needs to be balanced with opportunity to implement methods of achieving cost reductions. The traditional lump-sum contract provides a very strong incentive to the contractor (in principle they obtain 100% of any savings in cost below tender price, and bear 100% of any overruns). However, under traditional procurement the contractor lacks opportunity, because they are not able to influence the design.

In the public sector, trust appears to be higher where partnering relationships exist. Incentive contracts such as Pain-Gain share contracts could induce positive behaviour among contractors by enabling them to gain from effective and efficient management. Pain-Gain share contracts may provide sufficient incentive for cost reduction whilst at the same time providing increased opportunity to do something about it. They may however still provoke defensive behaviour due to the surviving penalty element. The share of cost reductions may be structured around the tender price, the cost consultant's estimated price from the pre-tender stage, or target costs such as a guaranteed maximum price.

Table 2.3 Incentive Plan Features (Ibbs, 1991:159-166)

No	Plan Feature	Description
1	Unilateral vs. negotiated plans	Unilateral plans – incentive plan is to be put in place after the award, involves only limited dialogue with the contractor, involves only a net bonus potential Negotiated plans – involves joint development of plan, input from both parties, greater time and effort to develop, owner may pay more than is received in return
2	Parameters	For reimbursable cost contracts – parameters are cost, schedule, quality and safety For fixed price contracts – parameters are schedule, safety and quality
3	Positive vs. negative incentives	Positive incentives – contractor's energies are directed towards developing more effective ways to achieve project objectives, Negative incentives – results in defensive performance, the focus is to avoid penalties and preoccupation with potential claims and adversarial relationships
4	End-of-project vs. milestone determination	End of project plans – bonus and penalties are directly linked to project result, requires less administrative effort Milestone plans – involves the risk that bonuses will be paid but final results will be disappointing, a portion of the incentive is assigned to each grading period
5	Quantitative vs. qualitative measures	Quantitative performance criteria – objective, used in conjunction with end-of-project incentives, preferred by owners because of their objectivity Qualitative criteria – subjective, applied with milestone incentive plans, require a high level of trust between the client and contractor to be effective
6	Offsite vs. onsite determination	Offsite determination – performed by non-project senior management Onsite determination – performed by project team personnel
7	Win/lose vs. conditional awards	Win/lose – Bonus is carried over and is awarded at the client's discretion, does not require additional funding approvals Conditional awards – Earned bonuses are paid in part at the time they are earned and the remaining banked, there is a linkage between interim achievements and final results
8	Bonus flow down	The client selects the contractor based on the availability of a small cadre of key people, the client negotiates an incentive plan that gives a stated percentage of earned bonus amount to these key people on the completion of their project assignment

The success of incentive contracts depend largely on the relationship between the client and the contractor. The contractor is appointed based on non-financial criteria such as service quality, and the ability to manage relationships. Trust characteristics are higher in

private sector coalitions than public sector ones and the public sector client is generally poor at managing relationships. (Smyth in Pryke et al, 2006:111-112).

In the UK, financial incentive systems for the governance of construction projects need to be further developed. While consultants are incentivised to manage their time input into a project through their conditions of employment, contractors are provided with opportunity and incentivised through partnering to innovate and reduce client's costs. The use of partnering and other forms of long term relationships sometimes makes matters worse and exposes the client to more opportunistic behaviour. The client therefore has to be able to effectively manage the supply chain to improve efficiency and drive down costs. (Pryke in Pryke et al, 2006:229).

Within the industry subcontractors and suppliers continue to occupy a subordinate position in the hierarchy of relationships in the supply chain. Subcontractors are not usually involved in the development of performance improvement measures and competitive tendering remains the principal mechanism for subcontractor selection, which is against the ethos of alliancing. Adversarial relationships therefore remain between contractors and their suppliers. A commonly held view among subcontractors is that incentive mechanisms are geared in favour of main contractors, who exploit supply chain management to drive down supplier profits in order to survive the volatility of the construction business cycle. (Dainty et al, 2001:842).

In the client's organisation, incentive theories may be used to analyse the motivation to engage the project coalition and manage project risk in a proactive way to achieve project objectives. Incentive theories suggest that the individual will increase his efforts in order to obtain a desired reward, and that they will work harder given specific reward or encouragement for good performance. Incentive theories will apply under the following conditions. (Handy, 1999:31-32).

(i) The individual perceives the increased reward to be worth the extra effort
(ii) The performance can be measured and clearly attributed to the individual
(iii) The individual wants that particular kind of reward
(iv) The increased performance will not become the new minimum standard

2.7 Risk Perception

There are two broad competing doctrines on how risks should be identified, measured and managed namely:

- Homeostatic and
- Collibrationist

The homeostatic view represents traditional risk management practice and advocates a scientific approach to risk management. It has its basis in probabilities and dominates the construction industry.

" .... it emphasises rationality in decision making, prevention rather than cure, anticipation rather than reaction, blame rather than forgiveness, objectivity and quantification rather than subjectivity and qualitative measures, independence rather than inter-dependence, elitism rather than collectivism, confinement rather than consultation, and structures and control rather than people and processes...." (Hood and Jones, 1996 cited in Loosemore, 2006 in Pryke et al, 2006:187).

Those that have a collibrationist perspective on the contrary argue that people are not necessarily rational while responding to risks, but perceive risks within the social and cultural networks in which they are located. They emphasise relationships and seek to manage project outcomes with the assumption that perceptions and responses to risk are irrational.

"... they believe that reliable forecasting is impossible in many areas ... the variety of stakeholders in organisations prevent aggregate goal setting ... emphasise consultation, collective and social responsibility ... argue that the ability of an organisation to respond to problems and opportunities is as necessary as prevention ..." (Hood and Jones, 1996 cited in Loosemore, 2006 in Pryke et al, 2006:187).

Risk perception affects those who comprise project teams. The responses formulated represent an aggregation of the perceptions and motivations of project actors towards risks. Various perspectives that may be taken are explained in Table 2.4.

2.8 Risk Communication

A key to effective delivery of complex projects is the management of communication and consultation with stakeholders, and their involvement in decision making. Senior management need to make decisions regarding the type and degree of responsibility they have to their stakeholders as social responsibilities must be balanced by financial responsibilities to investors and creditors. (Brammer et al., 2004:704). Risk management should take account of how people perceive the impacts of projects on the environment. Management should not be concerned only with the development of technical solutions to safety risk but should also seek to understand how project stakeholders live, perceive and cope with uncertainties created by construction activities. (Loosemore, 2006 in Pryke et al, 2006:190). To be effective, communication needs to be based on a mutual sense of respect for the positions and perspectives of all parties. (Kasperson et al, 1996 cited in Loosemore, 2006 in Pryke et al, 2006:190).

Table 2.4 Perspectives of Project Actors on Perceived Risk (Loosemore, 2006 in Pryke et al, 2006:191-193)

No	Perspective	Characteristics/Assumptions
1	Economic Perspective	People respond rationally to hazards by comparing costs and benefits People react best to the path of maximum potential benefit to themselves. (Neuman et al, 1953; Willet, 1951) Managers weigh the impact of decisions with personal objectives of stakeholders Reduces reliance on traditional risk assessment methods Focused on strategies to suit individual stakeholder
2	Psychological Perspective	People do not always behave rationally by basing their risk judgements on expected values. (Argyris, 1990; Tversky et al, 1981) Cognitive dissonance – downplaying of information that challenges current beliefs Availability bias – Recent events are rated as more probable than distant memories Anchoring bias – Higher probabilities are assigned for events for which information is available
3	Sociological Perspective	Risk is interactive and people are influenced by the perceptions of others around them Relies on community as a source of perception Reiterates the critical importance of risk communication to the risk management process (Kasperson et al, 1996) People do not learn about risk through direct experience but through the media, social institutions, pressure groups, networks of friends, neighbours and colleagues
4	Cultural Perspective	People form into groups based on common objectives and perceptions, and assign meanings to risk events People rely on patterns of habit and reinforcement of their values to make meaning of their world People perceive and respond to risk according to principles within their social organisations People are concerned with social and political meanings of technology to society and not just with selecting a safer design or production process

Improving on risk communication is not a guaranty there would not be conflicts between organisations and their stakeholders, but it offers an opportunity for people to be a part of the solution rather than the problem. (Loosemore, 2006 in Pryke et al, 2006:190). For risk communication to evolve, organisations need to evaluate both the process and outcome of their risk communication effort routinely. They would thereby be able to adapt their risk communication quickly to changes in their environment. Those involved in the risk communication effort should help to design the parameters of such evaluation. (Chess, 2001:187).

2.9 Measuring Perceived Risk

Three approaches for measuring perceived risk are discussed below (De Rodes, 1994:326).

2.9.1 The Revealed Preference Method

This method presumes that society has adjusted automatically to an acceptable risk-to-benefit balance and that risk and benefits can be accurately determined. If this is the case, the historic actions of society drawn from statistical records should disclose current perceptions of risk. It relies on data from information on the actions of individuals. A drawback of the revealed preference method is that it assumes that the individuals studied made rational decisions in the past about risks and the associated benefits that enabled society reach an essential optimum state between risks and benefits for an activity.

2.9.2 The Expressed Preference Method

This method involves drawing a representative sample of people and asking that sample to express its preference. This method may be used to evaluate the importance of various characteristics of risk and to rate perceptions of total risk and benefits accruing from different activities and technologies. Using the expressed preference method, (Fischoff, 1977 cited in De Rodes, 1994:326) showed that higher levels of social risk are accepted with activities perceived to be more beneficial to the individual.

2.9.3 The implied preference method

This method examines the societal institutions developed to cope with risk-benefit trade-offs in the past. Unlike the revealed preference method it does not use data based on information about individual actions. A limitation of this method is that the standards of society may have changed over time.

2.10 Cognitive Psychology

Perception is the process of acquiring, interpreting, selecting, and organising sensory information. The ability to conceptualise and interpret risks is limited by cognitive factors which include the following: (Crouch et al, 1982 cited in De Rodes, 1994:327).

Representativeness of events

Anchoring – ability to adjust perception incrementally from an initial impression

Availability – the ease with which occurrences are brought to mind

Other factors that affect risk perception include the immediacy of the effect, the availability of alternatives, knowledge about risk, the necessity of exposure, familiarity of

the risk, chronic as opposed to catastrophic risk, and the distribution of the risk. (Crouch et al, 1982 cited in De Rodes, 1994:327).

2.9.1 Theories of Risk Perception

Perception theories may be grouped as follow:

- Passive Perception and
- Active Perception

Five theories of risk perception are illustrated in Table 2.5 based on their ability to predict or explain "what kinds of people will perceive which potential hazards to be how dangerous" (Wildavsky et al, 1990 cited in De Rodes, 1994:326).

Table 2.5 Theories of Risk Perception (De Rodes, 1994:326)

No	Theory	Assumptions
1	Knowledge Theory	• People perceive technologies to be dangerous because they know them to be dangerous
2	Personality Theory	• There are people who are always risk takers and there are people who are always risk avoiders
3	Economic Theory (Wildavsky et al, 1990 cited in De Rodes, 1994:326)	• The rich are more risk accepting than the poor • The poor may be willing to accept risk if they stand to gain
4	Political Theory (Wildavsky et al, 1990 cited in De Rodes, 1994:326)	• Controversies over risk are a result of struggles over personal interests
5	Cultural Theory (Wildavsky et al, 1990 cited in De Rodes, 1994:326)	• Perception and risk acceptance are rooted in social and cultural factors • Individuals chose what to fear and how much to fear it in order to support their lifestyle

2.9.2 Risk Target

The Risk Target is an important concept in the perception of risk. People do not make the same estimate when they rate risk with respect to themselves, to their family or to people in general. Significant differences exist between perceived personal risk, family risk and general risk. Often people are in risk denial and perceive themselves as being less subjected to risk than others. Risk denial has been termed unrealistic optimism (Weinsten, 1987 cited in Sjöberg, 2000:2). The variation in the perception of risk across targets is a result of the degree of control that people feel they have over hazards and the extent to which they can protect themselves. (Sjöberg, 1991 cited in Sjöberg, 2000:3).

Much remains to be done in order to better understand risk perception. A major limitation of psychometric models of analysing perception is that they use mean data on behaviour

as these are less subject to error than actual data. Behaviour however is best analysed using actual ratings collected from people. Sjöberg (Sjöberg, 2000:4) has proposed a model to analyse risk perception that uses the concepts of risk sensitivity, risk attitude and specific fear. These relate to personality and clinical psychology. It posits that if attitude is a crucial factor in risk perception, then perception largely remains an expression of specific values.

Chapter Three Research Methodology

3.1 Introduction

This chapter describes the methodology which has been used to deal with the conceptual issues identified in the previous chapters. It highlights the processes by which data has been gathered and analysed. Primary data was gathered about 45 completed major TPI projects:

- The Change Management Team, Major Projects Directorate, Highways Agency
- Policy & Operations Delivery, Procurement Directorate, Highways Agency
- 'Estimating and Monitoring the Costs of Building Roads in England' (2007), The National Audit Office
- 'Review of Highway Agency's Major Roads Programme (2007),
  The Nichols Group
- http://www.highways.gov.uk (the website of the HA)

Interviews/telephone conversations were conducted, and a semi-structured questionnaire was administered to seven project sponsors and key staff of the HA in order to obtain information about the human side in the perception of project risk. The staff were located within Major Projects, Procurement and Finance Services directorates. Sixteen staff were approached who had been involved in the completed road projects and were still in the employment of the HA, but only seven of them participated in this study.

From a review of the existing literature on the psychology of perception, three methods have been identified which could be employed to analyse perception. These methods are:

- The revealed preference method (employs statistical data to determine current perception of risk)
- The expressed preference method (draws a representative sample of people and asks that sample to express its preference)
- The implied preference method (examines the societal institutions developed to cope with risk-benefit tradeoffs in the past)

All the three methods have been described in Chapter 2 and were employed in this study to analyse the perception of project risk in the HA. Although each method had its limitations, it is expected that by employing all three approaches, broad based insights would be gained into the issues involved in the perception and management of project risk in the HA.

3.2 Stages of Scheme Development

The present cycle for scheme development comprises 15 stages as shown in Fig 3.1 in Appendix 2. Stages 1 to 5 represent the period before TPI entry while Stages 6 to 15 represent the TPI. Gateway reviews are interposed between the stages as shown. Schemes enter into the TPI at an early stage of their development subject to satisfactory completion of statutory processes, consideration by DfT and ministerial appointment. Entry point is at OGC gateway review 2. The schemes are further developed and a target price for construction is agreed at OGC gateway review 3b. For the purpose of this study the agreed target price is referred to as the Ministerial Approved Budget (MAB). At OGC gateway review 5b the schemes are substantially completed and the outturn cost is determined.

3.3 Data Gathering

The network includes various types of road ranging from motorways ('M' roads) to dual and single carriageway trunk roads (the major 'A' roads). Other roads in England are managed by local authorities. The Agency is divided into eight business areas, called Directorates. The responsibilities of the eight directorates are summarised in Table 3.1. Most HA road projects are managed by 14 area teams that cover the whole of England. Very large projects have dedicated management teams or may be managed by private contractors. The 14 area teams are further grouped into six regions namely South West, London and South East, East, Midlands, North West and North East as shown in Fig 3.2.

Table 3.1 Highway Agency Organisational Structure

No.	Directorate	Responsibilities
1	Procurement	Determining procurement strategies Identification of the best suppliers Maintaining supplier performance records
2	Network Strategy	Regional planning Liaising with regional, government offices and development agencies Liaising with local authorities
3	Traffic Operations	Maintaining and managing the strategic road network asset Operating the network
4	Major Projects	Delivery of Major Schemes valued at more than £5 million including Targeted Programme of Improvements and large maintenance projects
5	Safety, Standards and Research	Maintaining best business practice approach to trunk road management, operation, and design Developing and managing research and development strategy Encouraging innovation and the introduction of new ideas
6	Finance Services	Business and financial control Resource accounting and budgeting Ensuring propriety and value for money Provision of computing systems and legal services
7	Human Resource Services	Developing policies and strategies for effective Human Resource Management Managing estate and office services
8	Information Directorate	Implementation of information technology projects Collection of roads information to support business decisions Provision of information direct to road users and the public

1: Cornwall & Devon

2: Somerset, Avon, Wilts, Gloucs & Devon

3: Berks, Bucks, Dorset, Hants, Surrey & Oxon

4: Kent, Surrey, East Sussex & West Sussex

5: Berks, Bucks, Essex, Herts, Kent & Surrey (M25 Area)

6: Essex, Cambs, Suffolk & Norfolk

7: Leics, Notts, Lincs & Derbyshire

8: Bucks, Herts, Beds, Essex, Cambs & Northants

9: Gloucester, Worcester, West Midlands, Warwickshire & Staffordshire

10: Cheshire, Merseyside, Greater Manchester, South Lancashire

11: Northants, Warwicks, Leics, Staffs & Shropshire

12: Yorkshire & North Lincolnshire

13: Cumbria & North Lancashire

14: Northumberland, Tyne and Wear, Durham & North Yorkshire

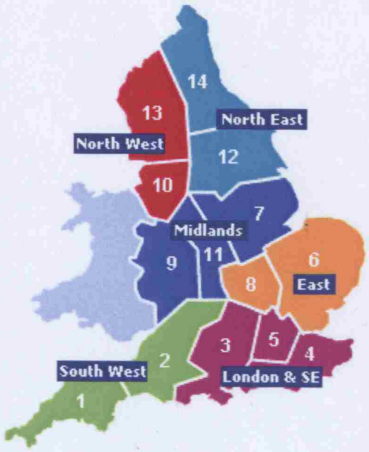


Fig 3.2 Highway Agency Area Teams and Regions
(Source http://www.highways.gov.uk/aboutus/143.aspx, accessed 27 September 2007)

3.4 Primary Data

The data collected included details of awards, project costs, project duration, procurement route, type of scheme and the project sponsor. Complete information was not available on targeted completion dates and as a result the time creep between project award and substantial completion could not be analysed.

The HA has indicated that the final accounts of some of the projects are still being agreed with contractors and suppliers. They have therefore requested that while the approved budgets and outturn figures may be analysed in this study, they may not be published at the present time. Those figured have therefore been suppressed in all the tables contained in this report.

3.5 Data Analyses

The independent variables which were studied included Project Entry Costs (PEC), Ministerial Approved Budget (MAB), Type of Scheme, Type of Procurement, Location of Project, and Project Duration. The dependent variable was the creep on Cost. Statistical analyses were performed on the collected data using parametric tests since the frequency of values showed a normal distribution. Statistical analyses were performed using SPSS version 15.0 statistical analysis software. The analyses performed are described in Table 3.2.

Table 3.2 Statistical Analyses Performed

No.	Statistical Analysis	Justification
1	Frequency distribution	The frequency of creep values showed a normal distribution about the mean and provided justification for the use of parametric tests.
2	Correlation Regression	Using scatter plots and lines of best fit, the relationships between the independent and dependent variables were analysed. The coefficient of correlation was obtained and was used to asses the strength of the linear relationship between the variables. The Pearson correlation coefficient was used.
3	Analysis of Variance (ANOVA)	One way ANOVA was used to analyse independent variables with several means. The ANOVA significance statistic tests whether there is a significant difference between the means compared. Significance statistics range from 0 to 1. A value of 0 represents no significance while a value of 1 represents very strong significance.

In order to obtain balanced and representative results, creep on costs was analysed in between three milestones along the project life cycle. The milestones were:

- At TPI entry
- At ministerial approval
- At substantial completion

3.6 Interviews/discussions with Project Managers and Key Staff

A modified questionnaire was distributed (see Appendix 1) which was followed on by telephone calls and visits to two regional offices of the HA at Bedford and Manchester. The questions were designed to obtain the views of HA staff about the HAs perception and management of project risk. The opening questions asked about the experience of the respondents. Other questions sought to confirm the effectiveness of risk management under the following headings.

- Experience of Project Management
- Risk Awareness
- Cost Estimation
- Risk Incentive
- Risk Communication
- Organisational Culture and Governance issues
- Organisational Learning

The choice of answers to some of the questions in the questionnaire were set at extreme values (True/Not True, A lot/Not a lot, Less than average/more than average, To a large extent/Not to a large extent, Very useful/Not very useful), and respondents were asked to answer such questions by giving their best estimate. The respondents were assured anonymity in the final report.

3.7 Analysis of Interview Responses

The findings from the questionnaires and interviews represent the observations, views and value judgements of seven individuals and as such they have not been analysed statistically. Where possible the predominant responses to the questions asked have been highlighted.

The HA is an organisation in transition and it is committing a lot of its resources to manage that change. It has put in place an action plan to implement the recommendations of recent reviews by the Nichols group and the National Audit Office. As a result, the people interviewed often could not give absolute answers to the questions they were asked especially as historical processes were being redesigned. The ongoing change programme therefore imposes some limitations on the representativeness of some of the findings of this study in the near future.

Chapter Four Data Analyses

4.1 Statistical Analyses (Adjusted Project Entry Costs - PEC)

Primary data was collected about 45 completed TPI schemes are shown in Table 4.1 (see Appendix 2). TPI entry costs were adjusted for non-recoverable VAT, contingency optimism bias and inflation. Adjusted entry costs are henceforth referred to as PEC. The percentage creep between PEC and ministerial approved costs (referred to as MAB) were calculated and are shown in Table 4.2 (see Appendix 2). The calculated data was then entered into SPSS for analysis as shown in Table 4.3 (see Appendix 2).

Projects with creep values greater than +50% or -50% of PEC have been excluded prior to analysis. SPSS returns a missing value for each of the excluded creep values. These extreme values have been excluded in order to prevent a distortion of the results of the analysis. There are nine missing values in the analysed data between PEC and MAB.

Adjusted costs were obtained from the NAO and the Change Management Team of the HA. The NAO had checked and validated the adjustments. Adjustments were made to estimates of TPI schemes that entered the programme before 2003 so that estimates should be directly comparable with later cost estimates and outturn costs. An allowance was made for non recoverable VAT on the works cost since other key elements (preparation, supervision and land) are fully VAT recoverable. Adjustments for optimism bias were based on the provisions of the Green Book on Appraisal and Evaluation in Central Government. Since 2003, the HA has estimated an allowance for inflation at the rate of 2.5% per year for 2001-2002 to 2007-2008 and 2.7% thereafter. (NAO, 2007:28-30).

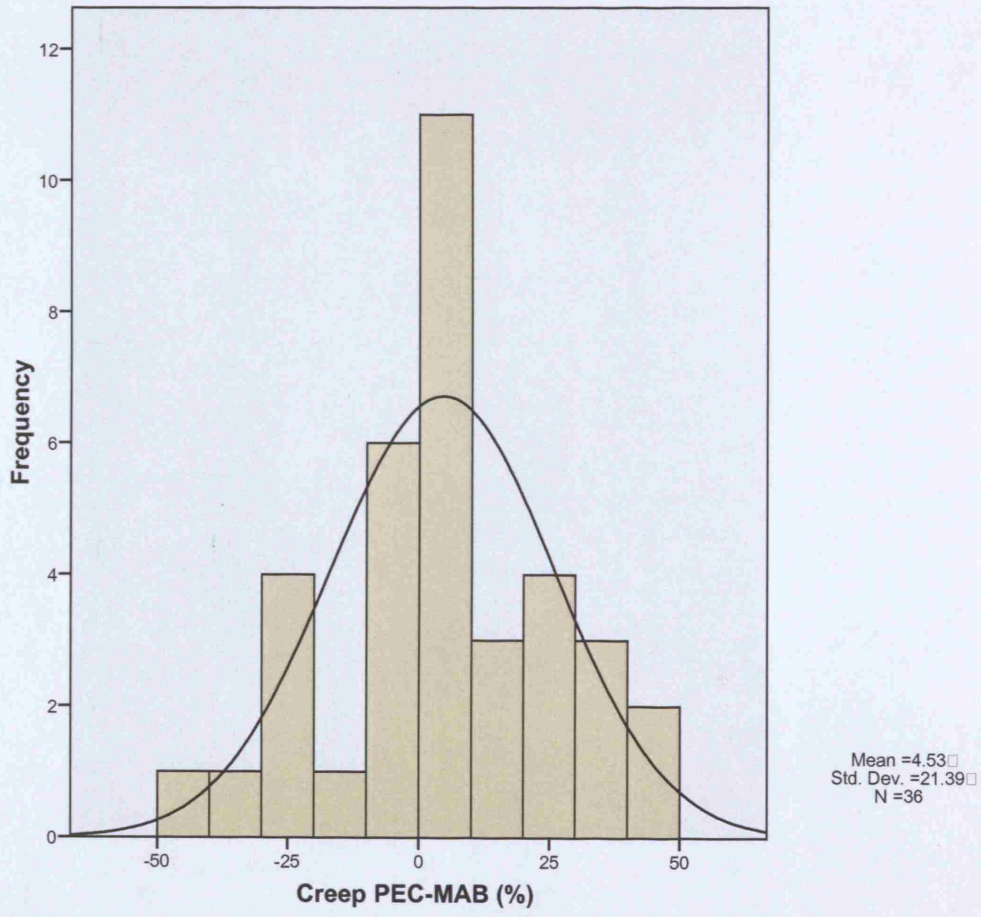
4.1.1 Frequency Distribution (% Creep on Adjusted Project Entry Costs)

Descriptive statistics for the frequency distribution of percentage creep values (PEC-MAB) are shown in Table 4.4. The frequency distribution curve is a normal curve and is shown in Fig 4.1.

Table 4.4 Frequency Distribution (PEC-MAB)

Statistic	Value
Valid Creep values (N)	36
Missing Creep values (N)	9
Mean Creep (%)	4.53
Standard Deviation	21.390
Variance	457.513
Range	91
Percentile 25	7.00
Percentile 50	3.00
Percentile 75	19.50

Fig 4.1 Frequency Distribution of Creep Values PEC-MAB



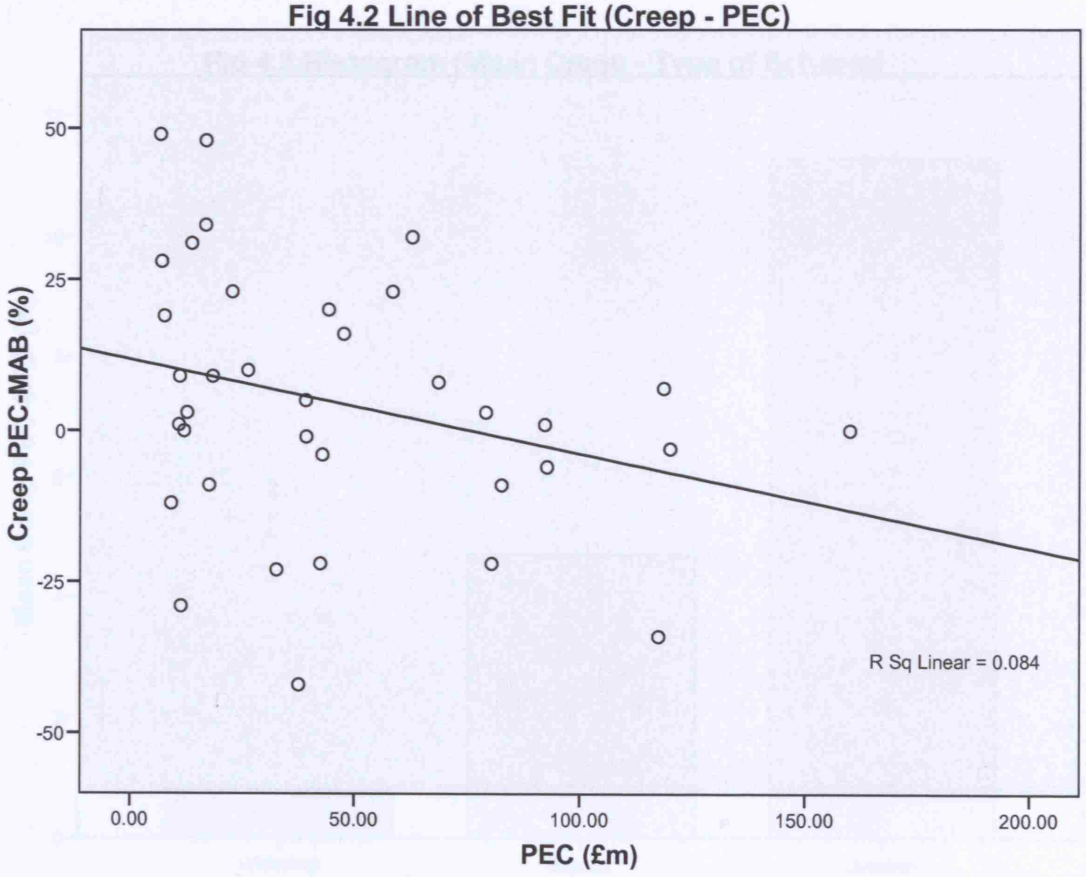
4.1.2 Relationship between Creep and PEC

A scatter plot and line of best fit showing the relationship between creep and PEC are shown in Fig 4.2. Nine creep values have been excluded leaving 36 remaining values. Mean PEC is 42.5676 (£m) and standard deviation of PEC values is 37.00508. Mean creep is 4.53% and standard deviation of creep values is 21.390. Correlation statistics are shown in Table 4.5.

Table 4.5 Correlation of Creep and PEC

		Creep PEC-MAB (%)	PEC (£m)
Creep PEC-MAB (%)	Pearson Correlation	1	-0.290
	Sig. (2-tailed)		0.086
	N	36	36
PEC (£m)	Pearson Correlation	-0.290	1
	Sig. (2-tailed)	0.086	
	N	36	45

Fig 4.2 Line of Best Fit (Creep - PEC)



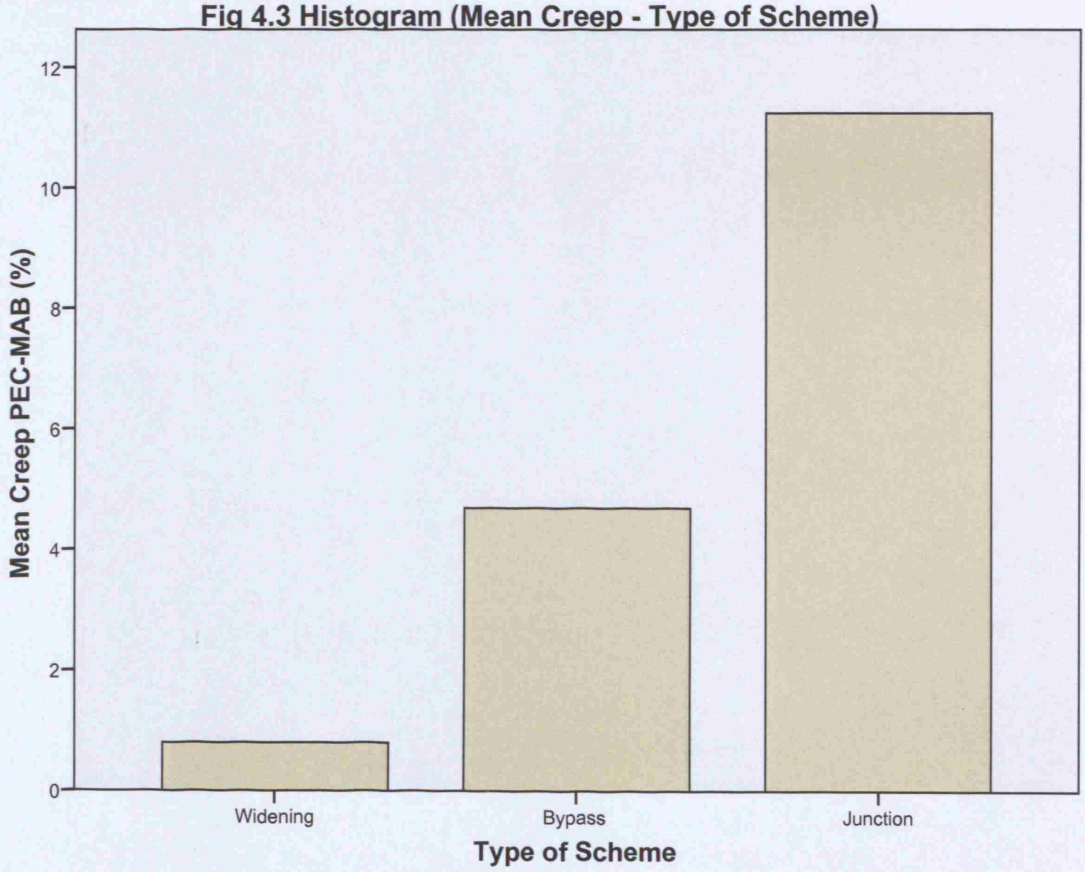
4.1.3 Relationship between Creep and Type of Scheme

A histogram showing the relationship between mean creep and type of scheme is shown in Fig 4.3. Using one way analysis of variance (ANOVA) 36 creep values were analysed. Descriptive statistics obtained from the analyses are shown in Table 4.6. The significance statistic is 0.550.

Table 4.6 One Way ANOVA: Creep and Type of Scheme

Type of Scheme	N	Min Creep	Max Creep	Mean Creep	Std. Deviation
Widening	15	-34	32	0.80	18.072
Bypass	13	-42	48	4.69	23.282
Junction	8	-29	49	11.25	24.973
Total	36	-42	49	4.53	21.390

Fig 4.3 Histogram (Mean Creep - Type of Scheme)



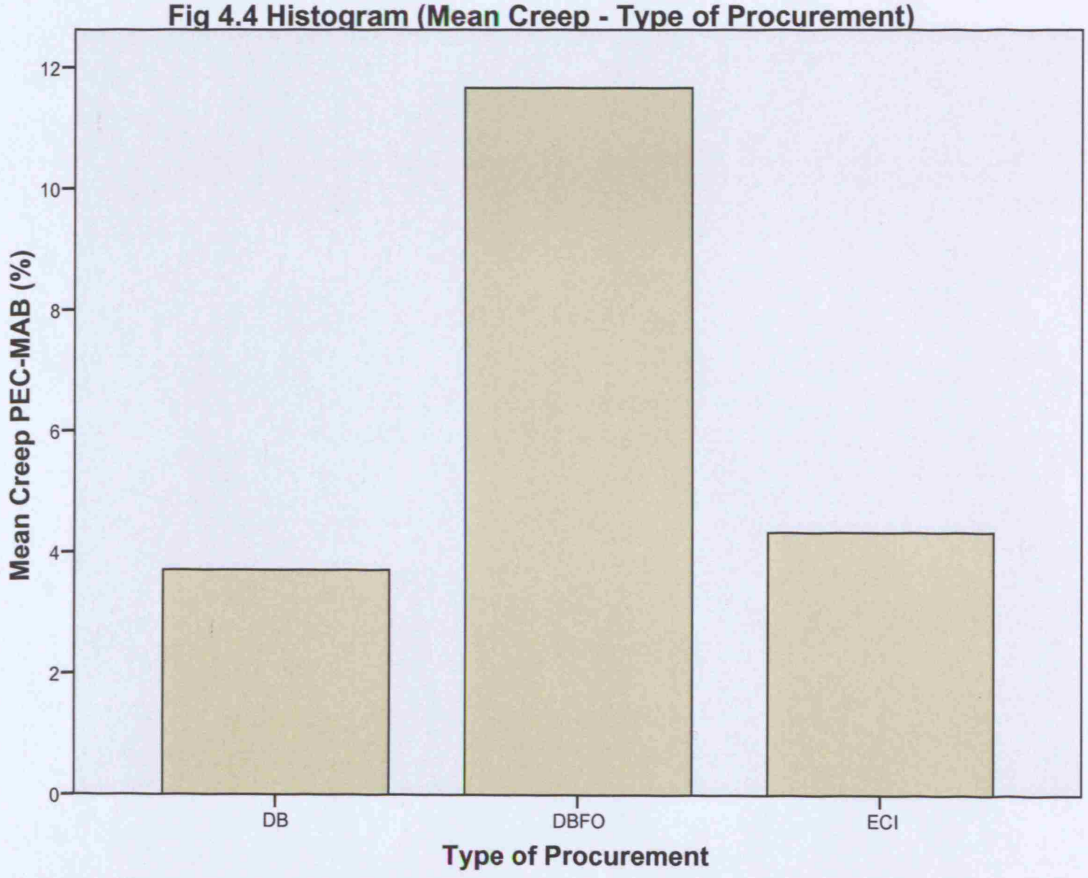
4.1.4 Relationship between Creep and Type of Procurement

A histogram showing the relationship between mean creep and type of procurement is shown in Fig 4.4. Using one way analysis of variance (ANOVA) 36 creep values were analysed. Descriptive statistics obtained from the analyses are shown in Table 4.7. The significance statistic is 0.839.

Table 4.7 One Way ANOVA: Creep and Type of Procurement

Type of Procurement	N	Min Creep	Max Creep	Mean Creep	Std. Deviation
DB	24	-42	49	3.71	24.948
DBFO	3	0	32	11.67	17.673
ECI	9	-9	28	4.33	10.630
Total	36	-42	49	4.53	21.390

Fig 4.4 Histogram (Mean Creep - Type of Procurement)



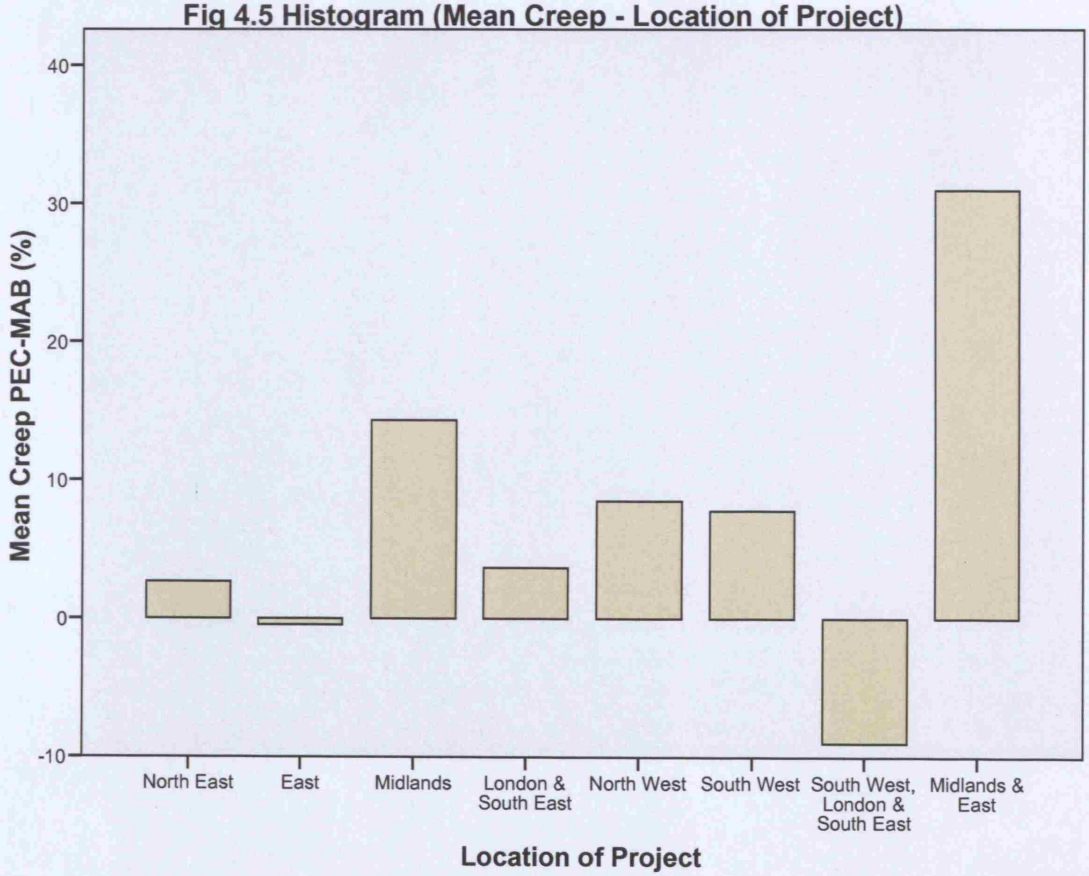
4.1.5 Relationship between Creep and Location of Projects

A histogram showing the relationship between mean creep and project location is shown in Fig 4.5. Using one way analysis of variance (ANOVA) 36 creep values were analysed. Descriptive statistics are shown in Table 4.8. The significance statistic is 0.883.

Table 4.8 One Way ANOVA: Creep and Location of Projects

Location of Projects (Region)	N	Min Creep	Max Creep	Mean Creep	Std. Deviation
North East	9	-29	34	2.67	22.489
East	9	-42	49	-.44	29.142
Midlands	3	-4	48	14.33	29.195
London & South East	6	-23	23	3.67	15.002
North West	2	-3	20	8.50	16.263
South West	5	0	28	7.80	11.862
South West, London & South East	1	-9	-9	-9.00	.
Midlands & East	1	31	31	31.00	.
Total	36	-42	49	4.53	21.390

Fig 4.5 Histogram (Mean Creep - Location of Project)



4.2 Statistical Analyses (Ministerial Approved Budget - MAB)

The percentage creep values between Ministerial Approved Budgets (MAB) and the Outturn cost of projects were calculated. The project data were then entered into SPSS for analysis as shown in Table 4.3 (see Appendix 2). Percentage creep values greater +50% or -50% of MAB have been excluded prior to analysis. SPSS returns a missing value for each of the excluded creep values. These extreme values have been excluded in order to prevent a distortion of the results of the analyses. There are seven missing values in the analysed data between MAB and Outturn Cost.

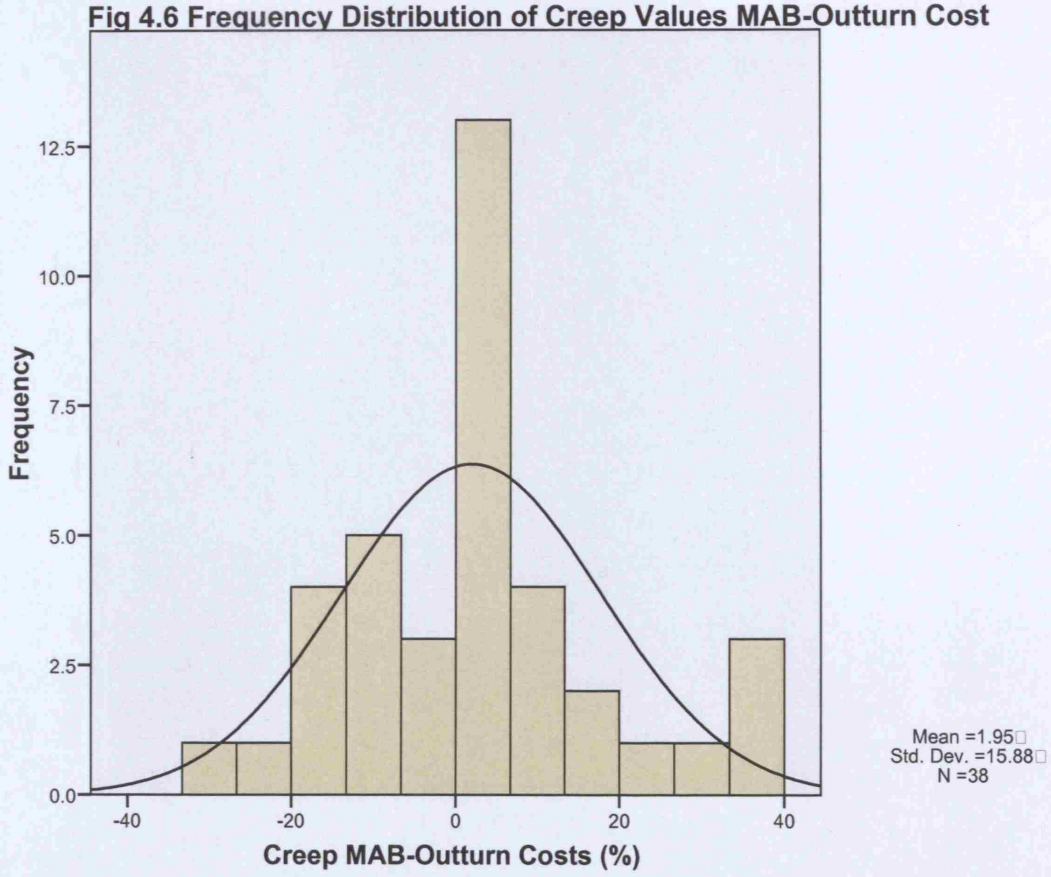
4.2.1 Frequency Distribution (Creep on Ministerial Approved Budgets)

Descriptive statistics for the frequency distribution of creep values (MAB-Outturn Cost) are shown in Table 4.9. The frequency distribution curve is a normal curve and is shown in is shown in Fig 4.6.

Table 4.9 Frequency Distribution (PEC-MAB)

Statistic	Value
Valid Creep Values(N)	38
Missing Creep Values(N)	7
Mean Creep	1.95
Standard Deviation	15.880
Variance	252.159
Range	68
Percentile 25	-8.00
Percentile 50	1.14
Percentile 75	9.75

Fig 4.6 Frequency Distribution of Creep Values MAB-Outturn Cost



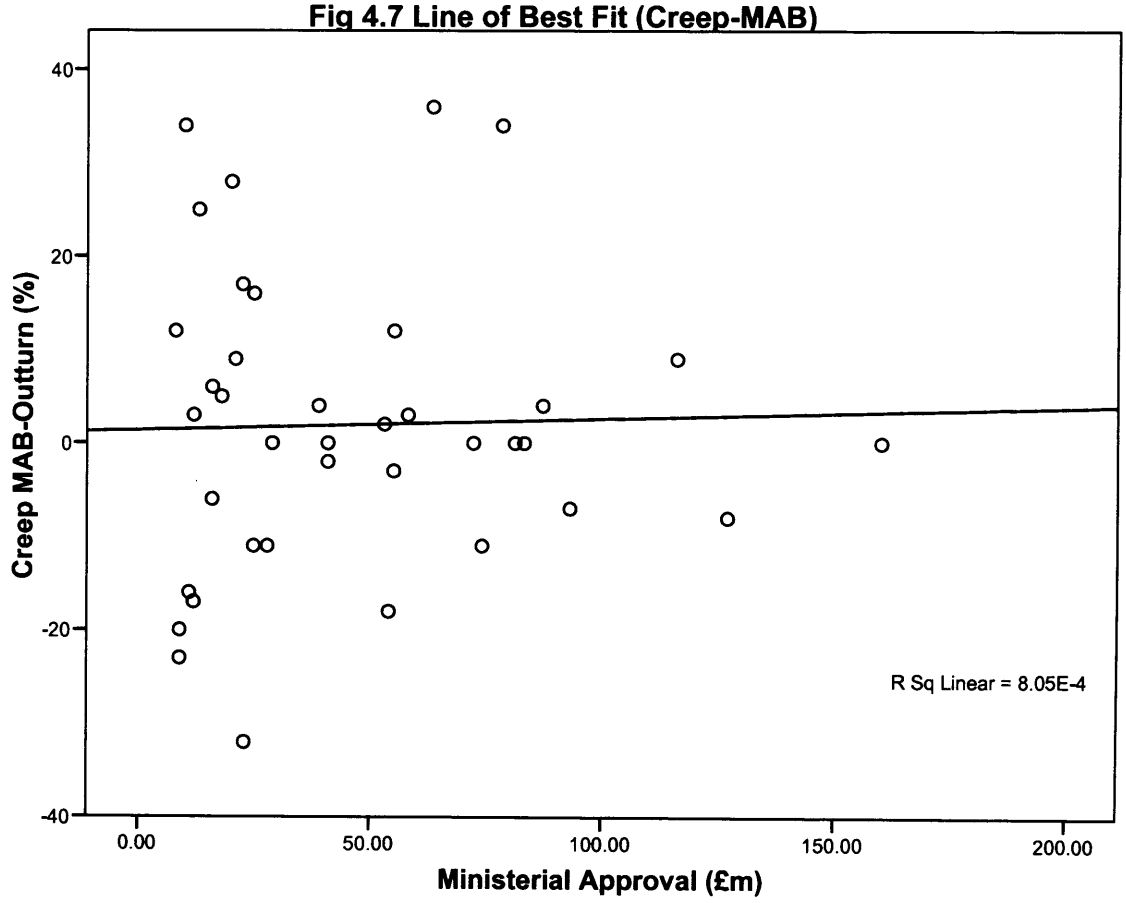
4.2.2 Relationship between Creep and MAB

A scatter plot and line of best fit showing the relationship between percentage creep and MAB are presented in Fig 4.7. Seven creep values were excluded leaving 38 remaining values. Mean MAB is 42.4996 (£m) and standard deviation of MAB values is 36.36176. Mean creep is 1.95% and standard deviation of creep values is 15.880. Correlation statistics are shown in Table 4.10.

Table 4.10 Correlation of Creep and PEC

		Creep MAB-Outturn (%)	MAB (£m)
Creep MAB-Outturn (%)	Pearson Correlation	1	0.028
	Sig. (2-tailed)		0.866
	N	38	38
PEC (£m)	Pearson Correlation	0.028	1
	Sig. (2-tailed)	0.866	
	N	38	45

Fig 4.7 Line of Best Fit (Creep-MAB)



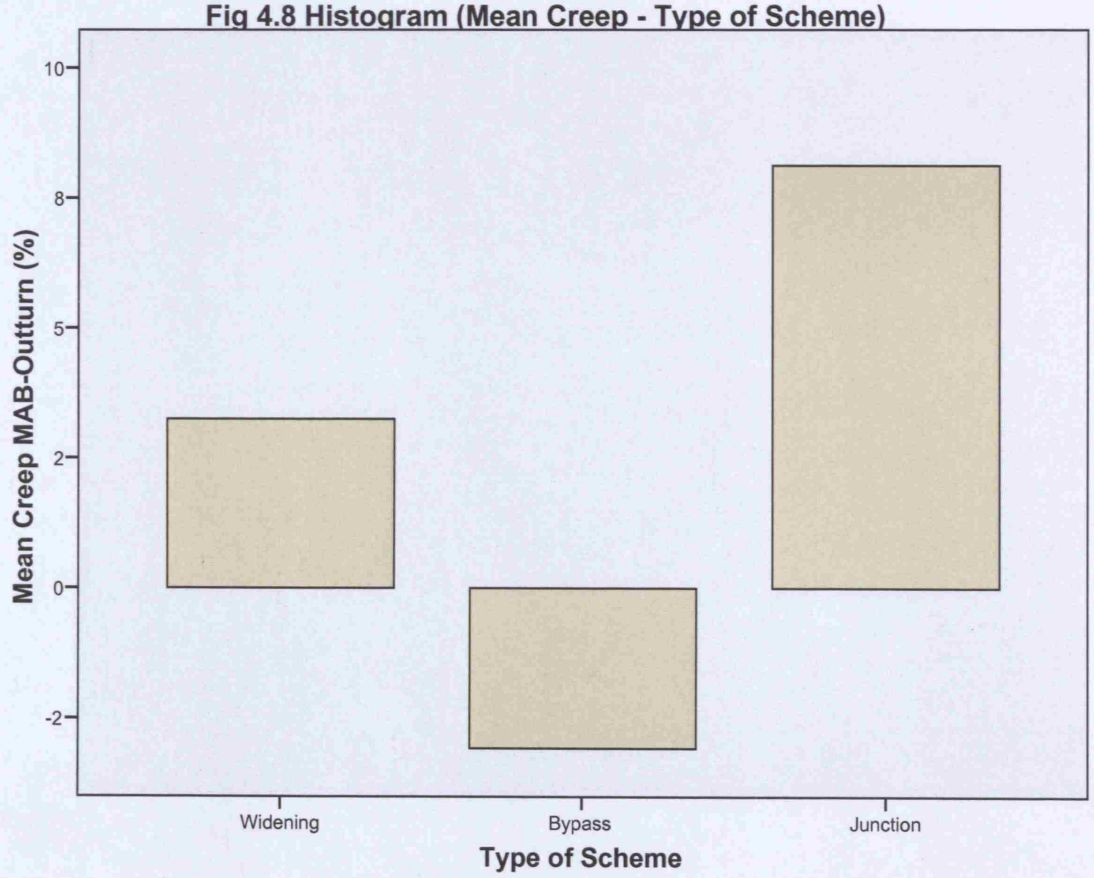
4.2.3 Relationship between Creep and Type of Scheme

A histogram showing the relationship between mean creep and type of scheme is shown in Fig 4.8. Using one way analysis of variance (ANOVA) 38 creep values were analysed. Descriptive statistics obtained from the analyses are shown in Table 4.11. The significance statistic is 0.263.

Table 4.11 One Way ANOVA: Creep and Type of Scheme

Type of Scheme	N	Min Creep	Max Creep	Mean Creep	Std. Deviation
Widening	16	-23	36	3.25	15.451
Bypass	14	-32	-23	-3.07	15.020
Junction	8	-20	-32	8.13	17.447
Total	38	-32	-20	1.95	15.880

Fig 4.8 Histogram (Mean Creep - Type of Scheme)



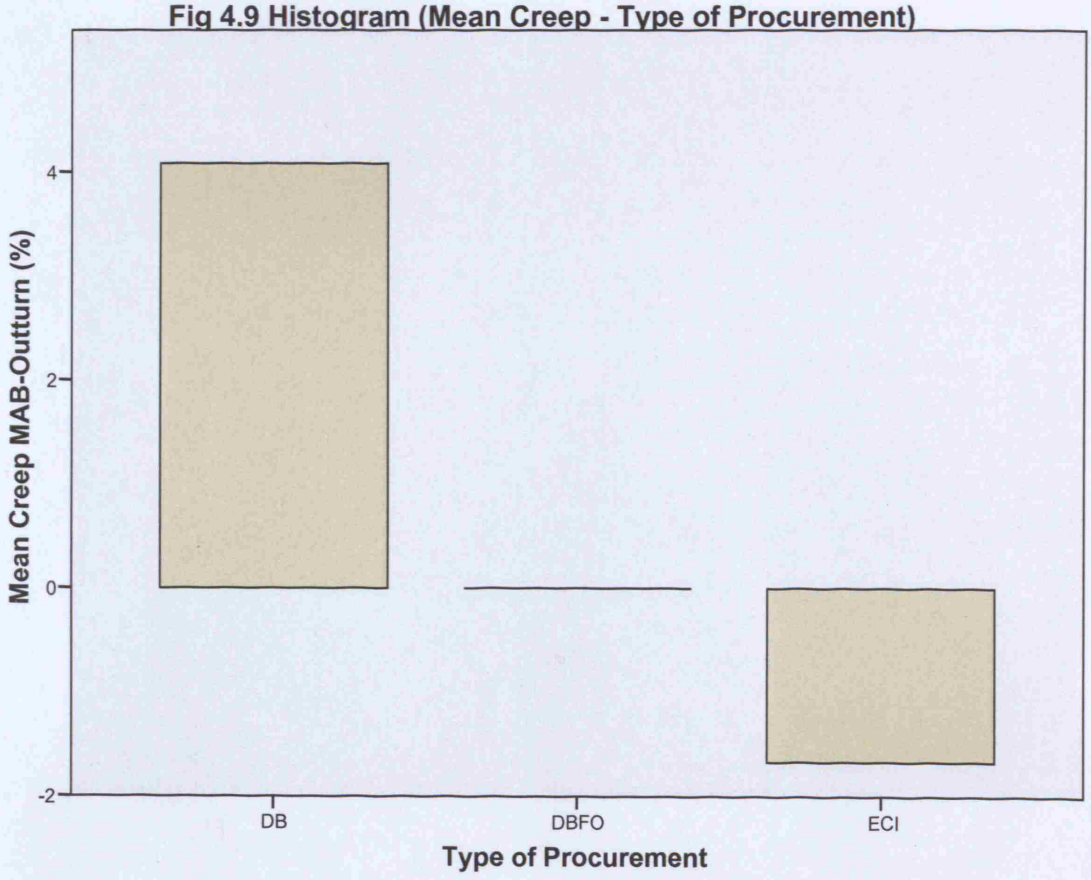
4.2.4 Relationship between Creep and Type of Procurement

A histogram showing the relationship between mean creep and type of procurement is shown in Fig 4.9. Using one way analysis of variance (ANOVA) 38 creep values were analysed. Descriptive statistics obtained from the analyses are shown in Table 4.12. The significance statistic is 0.594.

Table 4.12 One Way ANOVA: Creep and Type of Procurement

Type of Procurement	N	Min Creep	Max Creep	Mean Creep	Std. Deviation
DB	23	-32	36	4.09	17.975
DBFO	3	0	0	0	0
ECI	12	-23	25	-1.67	13.310
Total	38	-32	36	1.95	15.880

Fig 4.9 Histogram (Mean Creep - Type of Procurement)



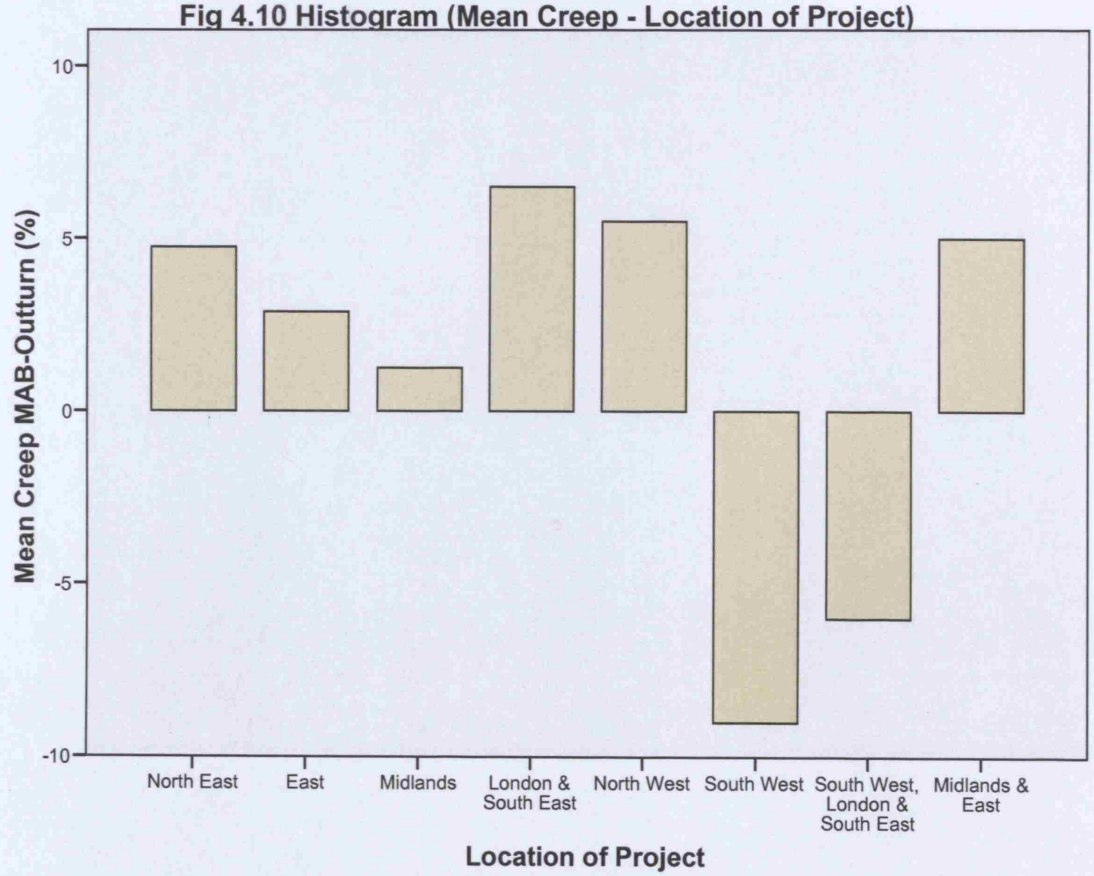
4.2.5 *Relationship between Creep and Location*

A histogram to show the relationship between mean creep and project location is shown in Fig 4.10. Using one way analysis of variance (ANOVA) 8 creep values were analysed. Descriptive statistics are shown in Table 4.13. The significance statistic is 0.793.

Table 4.13 One Way ANOVA: Creep and Location of Projects

Location of Projects (Region)	N	Min Creep	Max Creep	Mean Creep	Std. Deviation
North East	8	-20	36	4.75	17.261
East	8	-32	34	2.88	22.081
Midlands	4	-11	12	1.25	9.570
London & South East	8	-18	28	6.50	16.018
North West	2	2	9	5.50	4.950
South West	6	-23	6	-9.00	11.679
South West, London & South East	1	-6	-6	-6.00	.
Midlands & East	1	5	5	5.00	.
Total	38	-32	36	1.95	15.880

Fig 4.10 Histogram (Mean Creep - Location of Project)



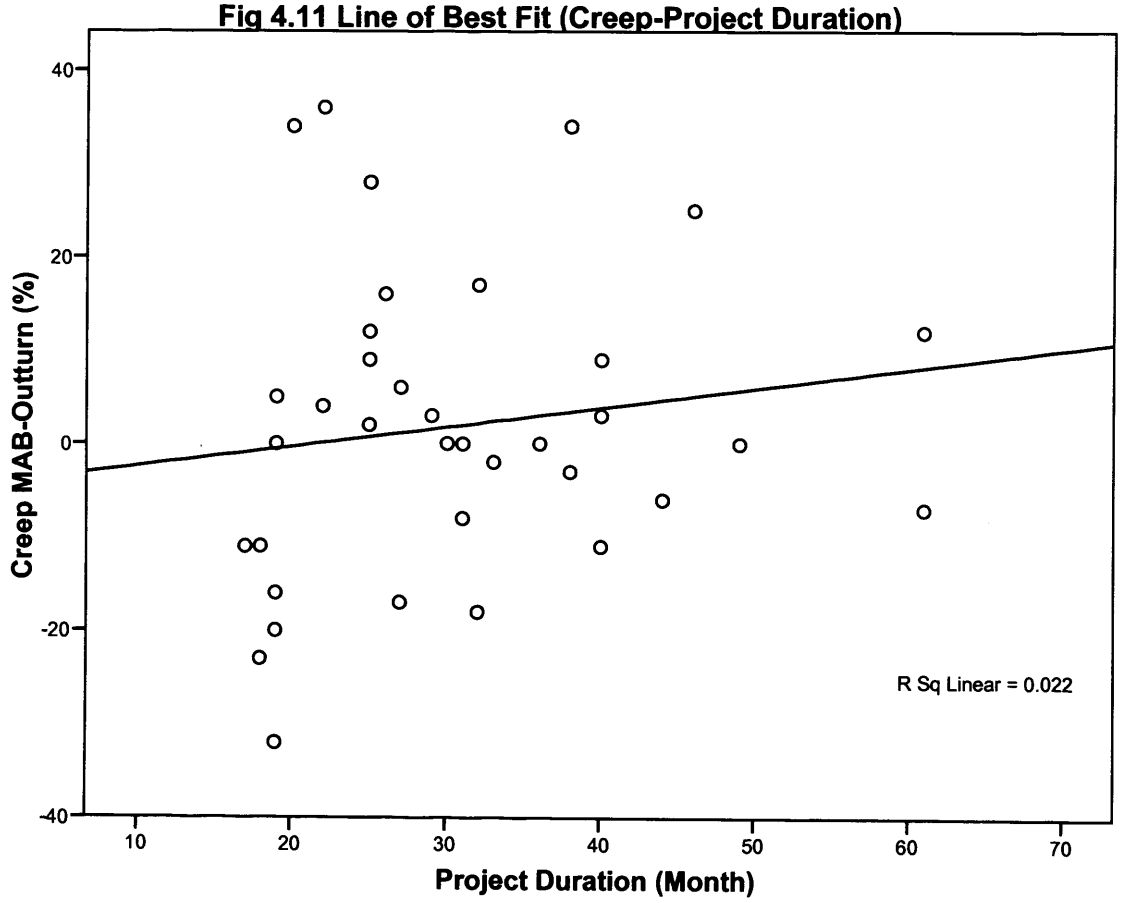
4.2.6 Relationship between Creep and Project Duration

A scatter plot and line of best fit showing the relationship between creep and Project Duration are presented in Fig 4.11. Eight creep values have been excluded leaving 36 remaining values. Mean MAB is 29.41 and standard deviation of MAB valùes is 10.823. Mean creep is 1.95% and standard deviation of creep values is 15.880. Correlation statistics are shown in Table 4.14.

Table 4.14 Correlation of Creep and Project Duration

		Creep MAB-Outturn (%)	Project Duration (months)
Creep PEC-MAB (%)	Pearson Correlation	1	0.147
	Sig. (2-tailed)		0.386
	N	38	37
PEC (£m)	Pearson Correlation	0.147	1
	Sig. (2-tailed)	0.386	
	N	37	44

Fig 4.11 Line of Best Fit (Creep-Project Duration)



4.3 Analyses of Interviews/Questionnaires

Sixteen HA project sponsors and key staff were approached out of which seven participated in interviews/telephone discussions, and responded to a semi-structured questionnaire. Thirteen of those approached were identified as having been project sponsors on some of the 45 completed TPI projects who are still in the employment of the HA. The other three are key staff who are involved in the strategic management of business and project risk. Four staff did not respond to the invitations to participate, two were on leave and could not be reached, while two others declined to participate stating they no longer were involved in the delivery of major projects. A project sponsor declined to participate on the grounds that the questions in the questionnaire asked for value judgements which they did not feel equipped to make. The findings from the seven participants are presented below under the relevant headings.

4.3.1 Experience of Project Management (Questions 1-3)

Six out of the seven respondents have been in the employment of the HA for over 10 years, while the seventh participant has worked in the HA between six and ten years. Five participants have been HA project sponsors for over ten years while a sixth has been a project sponsor between six and ten years. Two respondents have individually managed over 20 projects while four participants have managed between 11 and 20 projects.

4.3.2 Risk Awareness (Questions 4, 5, 6, 7, 8, 9)

All respondents were of the view that the HA considers effective risk management to be critical to realising project success and that consideration is given to managing risk during project planning and delivery. Five respondents agreed that the HA regularly reviews and improves its risk management process. Four respondents observed that the level of perceived risk at project inception did not affect the actual resources allocated to the project.

4.3.3 Cost Estimation (Questions 10, 11, open questions)

All respondents agreed that within the HA it is important that estimates be prepared as accurately as possible. Six of them answered 'Not a lot' when they were asked about the extent to which individual project managers could be penalised for inaccurate estimates during project planning or delivery. Respondents observed that the periods between TPI entry and implementation were too long for reliable estimates to be prepared (sometimes up to ten years). Scope changes and inappropriate provision for inflation affect the estimates. Other factors that were cited as affecting the reliability of cost estimates

include the use of single value estimates rather than range forecasting, reliance on third parties for the development of estimates, inadequate internal expertise to price uncertainty, unavailable information on actual project costs as a guide when developing estimates.

4.3.4 Risk incentive (Questions 13, 14, 15)

Six respondents answered 'A lot' when they were asked if project managers were personally accountable for identifying risks during project planning and for mitigating identified risks during delivery. Five of them opined that individual project sponsors were assessed based on the overall performance of projects within their portfolio and not just on the outcome of individual projects. The staff appraisal and review process is based on achieving agreed objectives in the staff development plan. The gateway review for major projects provides an incentive to adequately assess risk in order for schemes to be progressed. There is no direct relationship between project management skills and pay. Remuneration for senior staff is based upon work and recommendations of the review board on senior salaries. New project managers are presently being recruited on short term contracts that offer flexibility in terms of remuneration and rewards for the right skills.

4.3.5 Risk Communication (Questions 5, 16, 20, 23, 26)

Four participants were of the view that the HA has extensive documentation on its preferred approach/attitude to risk management. During discussions however, a recurring comment was that a lot of the actual risk management is carried out by consultants and contractors who are allowed to use their own risk management applications. Five respondents agreed that the HA actively promotes proactive risk management, and six respondents observed that corporate policies are communicated to project management staff to a large extent. All participants agreed that there are individuals within the HA who are responsible for promoting proactive risk management. There appears to be more lateral communication among staff involved in strategic management of risk than those involved primarily in managing project risk.

4.3.6 Organisational Culture and Governance Issues (Questions 12, 18, 19, 21, 22)

All respondents agreed that different interest groups exist within the HA with regards to risk management. Five were of the view that some people have more power/influence than others. Four agreed that where differences occur they are resolved to a large extent. Six of the respondents were of the view that compliance with governance rules

and regulations has a positive effect on project risk management and the ability of project sponsors to manage risks effectively. Top management were observed to be more directly involved in business and strategic risk management than project risk. Project managers were found to welcome the implementation of the Nichols review.

4.3.7 Organisational Learning (Questions 24, 25, 27, 28, 29, 31)

Six respondents answered 'Not very well' to the question 'How well would you say the HA measures the success of project risk management?' Four respondents believed the HA has learned a lot from its successes and failure in the past. Four respondents answered 'Less than average' to the question 'How much training and learning programmes in risk management does the HA provide for project managers?

Chapter Five Discussions

This study aimed to analyse the perception and management of project risk in the delivery of major road projects in the Highways Agency. It conceptualised perception and risk management in the context of a client's organisation. Forty five completed TPI road projects were analysed with a view to gain a better understanding of the issues involved in risk management during the delivery stage of projects. This section of the report contains discussions of the results of the analyses of data collected and of findings from interviews/discussions with HA project sponsors and some key staff who have been involved in the delivery of projects within the TPI.

5.1 Statistical Analyses

Variance in cost was studied during two stages of the project life cycle namely:

(i) Development stage (between TPI entry and ministerial approval)

(ii) Construction stage (between ministerial approval and substantial completion)

Relationships between variance in cost and some project variables were analysed and the results are summarised in Table 5.1. Results from the analyses are discussed below.

5.1.1 Frequency Distribution of Creep Values (Figs. 4.1 and 4.6)

Calculated creep values (positive and negative) follow a normal curve distribution for both stages (i) and (ii) when the cumulative frequencies of occurrence of creep values were plotted in scatter plots. Since extreme creep values had been excluded from the analyses, it could be assumed that analysed creep values act independently and additively. Mean creep in Stage 2 (1.95%) was observed to be less than mean creep in Stage 1 (4.53%). An explanation for the lower value of mean creep in Stage 2 is that Stage 1 is typically characterised by scope changes and TPI entry cost estimates are not reliable. In Stage 2 however the construction project is well defined and the use of Design and Build could make changes in scope very costly to the client.

Standard deviation measures the spread of data about the mean. It tends to zero as data values are more equal. The standard deviation in both Stages 1 and 2 are large (21.39 and 15.88 respectively) hence the large variances (457.513 and 252.159). The low value of mean creep is a result of the averaging effect of negative creep on positive creep values. Large cost overruns on individual projects could actually be concealed by reduction in scope during construction. Scope changes (positive or negative) occurred on a significant number of projects in Stage 2. Negative scope changes made at such a late stage do not result in a reduction of the whole life cost of a project and may actually reduce the value to be derived from the built asset.

Table 5.1 Summary of Statistical Analyses

No.	Study Parameters				Project Life Cycle	
					Development Stage 1	Construction Stage 2
					N=36	N=38
1	Frequency Distribution of % Creep Values	Mean (%Creep)			4.53	1.95
		SD (%Creep)			21.39	15.88
		Variance			457.513	252.159
		Range			91	68
		Percentile 25			7	-8
		Percentile 50			3	1.14
		Percentile 75			19.5	9.75
2	Creep & PEC, Creep & MAB	Mean PEC/MAB (£m)			42.5676	42.4996
		SD (PEC)			37.00508	36.36176
		Correlation Coefficient			-0.29	0.028
		Significance Statistic			0.086	0.866
3	Creep & Type of Scheme	Significance Statistic			0.55	0.263
		Type of Scheme	W (N=15)	Mean Creep	0.8	3.25
				SD	18.072	15.451
			B (N=13)	Mean Creep	4.69	-3.07
				SD	23.282	15.02
			J (N=8)	Mean Creep	11.25	8.13
				SD	24.973	15.88
4	Creep & Type of Procurement	Significance Statistic			0.839	0.594
		Type of Procurement	DB (N=24)	Mean Creep	3.71	4.09
				SD	24.948	17.975
			DBFO (N=3)	Mean Creep	11.67	0
				SD	17.673	0
			ECI (N=9)	Mean Creep	4.33	-1.67
				SD	10.63	15.88
5	Creep & Project Location	Significance Statistic			0.883	0.793
		Project Location	NE (N=9)	Mean Creep	2.67	4.75
				SD	22.489	17.261
			East (N=9)	Mean Creep	-0.44	2.88
				SD	29.142	22.081
			Midlands (N=3)	Mean Creep	14.33	1.25
				SD	29.195	9.57
			London & SE (N=6)	Mean Creep	3.67	6.5
				SD	15.002	16.018
			NW (N=2)	Mean Creep	8.5	5.5
				SD	16.263	4.95
			SW (N=5)	Mean Creep	7.8	-9
				SD	11.862	11.679
			SW, London & SE (N=1)	Mean Creep	-9	-6
				SD	-	-
			Midlands & East (N=1)	Mean Creep	31	5
				SD	-	-
6	Creep & Project Duration	Mean (MAB)			-	29.41
		SD (MAB)			-	15.88
		Correlation Coefficient			-	0.147
		Significance Statistic			-	0.386

N=No of Schemes, SD=Standard Deviation, PEC=Adjusted TPI Entry, MAB=Ministerial Approved Budget

W=Widening, B=Bypass, J=Junction

DB=Design and Build, DBFO=Design Build Finance Operate

5.1.2 *Relationship between Percentage Creep and Project Scope (Figs. 4.2 and 4.7)*

The purpose of this analysis was to determine if percentage creep was influenced by the size of projects. The correlation coefficient between percentage creep and PEC was -0.290 which indicates a weak negative correlation, while the correlation between percentage creep and MAB was 0.028 indicating a very weak positive correlation. During construction large road projects have several components that introduce complexity to project management. The expected relationship therefore would be for a strong positive correlation between creep and project scope. It appears that the numbers of projects with positive creep values approximate projects with negative values. This explains the weakness of the correlation. Large cost overruns on individual projects may therefore be balanced out by a reduction in scope. The large standard deviations of 37.00508 and 36.36176 in PEC and MAB respectively support this argument.

5.1.3 *Relationship between Percentage Creep and Type of Scheme (Figs. 4.3 and 4.8)*

TPI schemes are typically subdivided into three types namely widening schemes, bypass schemes and junctions. Junctions are the most complex to develop and construct as decisions have to be made on such factors as grade separation or the use of roundabouts, or the length of slip road access to be provided. Analysing the cost benefit ratios of design options for junctions would therefore be more complex than for widening or bypass schemes. The results of the analyses support this argument. During both the development and construction stages, the highest mean creep values recorded were for junction schemes. The standard deviations about the mean for all three types of schemes are consistently high. This is a result of the variability of the scope of work in the individual projects.

5.1.4 *Relationship between Percentage Creep and Type of Procurement (Figs. 4.4 and 4.9)*

During the development stage DBFO schemes recorded the highest mean creep of 11.67%. This result was expected as a lot of resources are committed to DBFO procured schemes during the development stage since the special purpose vehicle that would implement the scheme requires a firm agreement on the scope of work. Greater attention is therefore expected to be paid to uncertainty and risk events that could affect the scope of work during construction. The DBFO schemes expectedly recorded zero creep in the construction stage.

Mean creep values for Design and Build as well as ECI procured projects are considerably lower during the development stage. Mean creep obtained was 3.71% and 4.33% respectively. Although the schemes benefit from early engagement of consultants and contractors during the preparation of statutory processes and design, there is still flexibility for scope changes during construction albeit at a premium.

5.1.5 Relationship between Percentage Creep and Project Location (Fig. 4.5 and 4.10)

Forty three of the completed projects that were studied do not cross regional boundaries. The remaining two projects cross regional boundaries. These two projects introduced two additional variables with one sample in the analysis of the relationship between creep and project location. The results of the analyses are therefore not representative of the relationship between creep and project location and are not discussed further.

5.1.6 Relationship between Percentage Creep and Project Duration (Fig. 4.11)

The purpose of this analysis was to determine whether percentage creep was influenced by the duration of projects during construction. Complete information on programmed completion date was not available and as a result, the creep in time could not be analysed. The correlation coefficient between percentage creep and project duration was -0.147 which indicates a weak positive correlation. The time required to build a road depends on the scope of the work and projects with a long life cycle would be more prone to overrun on cost. The expected relationship therefore would be for a strong positive correlation between creep and project duration. Again it appears that the number of projects with positive creep is almost the same as projects with negative creep. This explains the weakness of the correlation. Mean creep during construction was only 1.95% but the large standard deviation of 15.880 supports this argument.

5.2 Findings from Interviews and Discussions with Staff

From discussions with project sponsors and key staff of the HA and the completed questionnaires, a lot of insight was gained about the perception of project risk within the HA. Some of the findings are discussed below using relevant subheadings which had been developed in the conceptual framework.

5.2.1 Experience of Managing Risk

Many project sponsors were experienced highway engineers who were not trained originally in project management but learned through experience. Project management

capabilities of project sponsors therefore range from 'developing' to 'very good'. The HA is conducting a skills assessment of its staff with a view to roll out training programmes to develop capacity in project management. Project risk is managed by consultants and contractors using a variety of applications but project sponsors are responsible for demonstrating a proper risk assessment at gateway reviews in order to progress schemes. Some project sponsors expressed a need for training to improve their commercial skills.

5.2.2 *Risk Awareness*

The HA is risk aware as evidenced by various risk management functions, processes and products within the agency. In a recent internal report "Analysis of Significant Reasons for Cost Increases" (Highways Agency, 2006), it reported that risk accounts for 8% of the total cost increases in 35 surveyed TPI projects (see Fig 5.1). The level of identified risk on projects however does not affect the actual resources deployed to manage projects. This could be as a result of projects being managed solely by area teams. Importantly the TPI is not a program of projects.

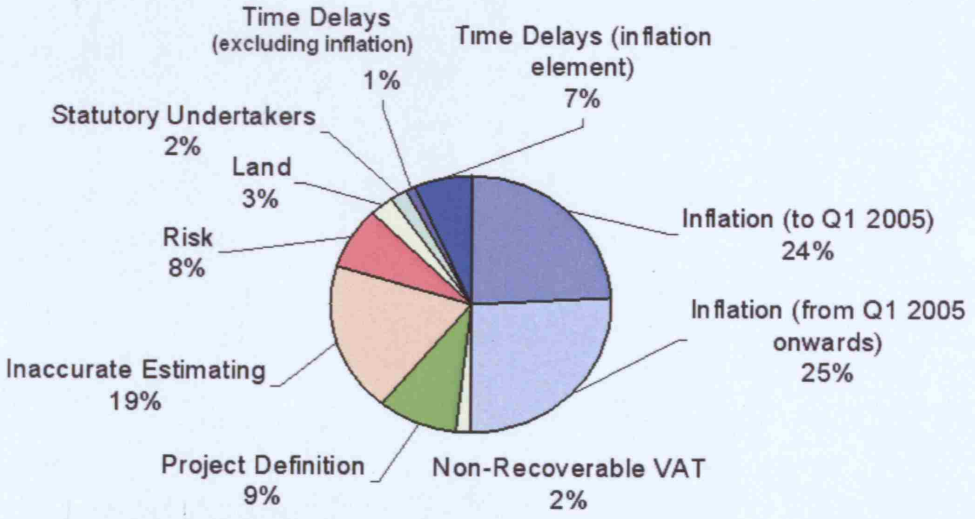


Fig 5.1 Reasons for Variance between TPI Entry Costs and Estimated Costs by Sept 2006 (Source: Highways Agency)

5.2.3 *Cost Estimation (Range Estimating)*

Factors that were commonly cited as affecting the reliability of cost estimates were scope changes, inadequate adjustment for construction industry inflation, reliance on third parties for the development of estimates, inadequate internal expertise to price

uncertainty, unavailable information on actual project costs as a guide when developing estimates and use of single value estimates instead of range estimating.

In the construction industry, attempts to quantify inherent construction risk more reliably have focussed on range estimating and probabilistic scheduling. The Nichols report recommended range estimating as a way of improving estimates in the HA. The report recognised that range estimation would rely on the availability of outcome costs which could be used to refine forecasts. The HA would face considerable difficulty gathering the data. It has not had a centralised system or repository and most of its project risk information reside in disparate formats within systems belonging to several consultants, contractors, and suppliers.

5.2.4 Risk Management Incentive

This study was unable to confirm how the HA plans to incentivise client project managers to manage risk more pro-actively. Presently contractors could be motivated to do so by the pain/gain share, and consultants through their conditions of engagement. For project sponsors however there is no direct relationship between project management skills and pay. The agency is presently beefing up guidance and monitoring compliance with contract audits and this could provide an indirect incentive to project sponsors to engage more effectively with consultants and contractors. This would only deliver limited benefits as a commonly held notion about the public service is that the reward system is *geared to reward not failing as opposed to succeeding*. The HA recognises the challenge and is presently seeking to attract project managers with the good project management skills on short term flexible contracts.

5.2.5 Risk Communication

During discussions, a respondent observed that bottom to top communication of risk is very effective within the HA. This is due largely to the reporting requirements of the gateway review process. Risks that could not be managed at the project level are escalated to the next level. A simplified bottom to top risk communication process is shown in Fig 5.2. Top to bottom risk communication is not effective as there are no direct incentives to share risk information with consultants, contractors and suppliers at the bottom of the supply chain. The HA does not have a system to communicate risk laterally across projects. As a result, knowledge learned while managing project specific risks may not be shared with other project teams. Teams do not routinely communicate with one another.

5.2.6 Organisational Learning

This study confirmed that there was some scope for staff in the Major Project directorate to learn through formal and informal interactions with staff in other directorates and organisations. They liaise with staff in Safety, Standards and Research, and Traffic Operations directorates. Such learning however appears to occur mainly in the management of strategic risks and not project risks.

In order to develop competencies organisations need knowledge. That knowledge resides in the minds and experiences of individuals within the organisation as tacit knowledge which cannot be readily expressed; or as explicit knowledge which has been codified. Where the primary emphasis for learning is on the use of guidelines and manuals, there is little evidence of effective learning.

Fig 5.2 Simplified Risk Communication Process

Within the organisation there are long serving and experienced staff that possess a wealth of knowledge. It is imperative for the HA to adapt its systems to capture, share, reuse and maintain the knowledge possessed by its people. Individuals within the organisation as well as the organisation as a whole are thus able to learn.

5.2.7 Risk Attitude

To conclude this section of the report it would be imperative to attempt to determine the risk profile of the HA as was earlier conceptualised. The agency is in transition and has in recent years implemented innovative ideas such as the use of novel materials in

construction, a traffic radio that broadcasts the latest traffic conditions, the use of variable message signs as well as information and communication technologies.

The classic academic view is that public sector clients are 'very risk averse' and therefore do not like surprises on projects especially cost and time slippages. This study would however not profile the HA as being risk averse. The findings reveal that it appears to be a risk tolerant organisation as it demonstrates most of the characteristics that go with that risk profile.

Chapter 6 Conclusions and Recommendations

6.1 The Study

This study aimed to analyse the perception and management of project risk in the delivery of major road projects in the United Kingdom by using the Targeted Programme of Improvements in the Major Projects Directorate of the Highways Agency as a case study. Based on the findings of the study, recommendations would be made to complement the prescriptions of previous reviews to improve risk management in the delivery major road projects.

Primary data was gathered from various sources about forty five completed TPI projects. Although there are other road programmes within the Major Projects directorate, this study has only considered completed road projects within the TPI in order to take advantage of the similarities in the processes which are applied to the schemes from inception, through planning, to procurement and delivery, and thereby draw meaningful conclusions about attitudes to project risk within the HA. Only completed road projects have been analysed as ongoing schemes remain subject to scope changes before they reach substantial completion. Parametric analyses were performed on the data using SPSS version 15.0 statistical analysis software. The analysed variables were Project Entry Costs, Ministerial Approved Budget, Type of Scheme, Type of Procurement, Location of Project, Project Duration, and cost creep. Creep was analysed between three milestones during the project life cycle namely:

- At TPI entry
- At ministerial approval
- At substantial completion

The full results of the statistical analysis have been presented in Table 5.1.

Sixteen staff of the HA were approached for interviews who were identified as having been involved in the completed road projects and were still in the employment of the HA of which seven participated in this study. Interviews/telephone conversations were conducted, and a semi-structured questionnaire was administered to seven project sponsors and key staff of the HA in order to obtain information about the human side in the perception and management of project risk. Questions were asked about the following:

- Experience of Project Management
- Risk Awareness
- Cost Estimation

- Risk Incentive
- Risk Communication
- Organisational Culture and Governance issues
- Organisational Learning

The findings from the questionnaires and interviews represented observations, views and value judgements of seven individuals and as such could not be analysed statistically. These findings have therefore been reviewed and discussed in Section 5.2.

6.2 Conclusions

6.2.1 One of the propositions of this study was that attitudes to risk by people acting individually or in groups within an organisation introduce an additional element into the risk management process, and the mere existence of principles, well defined processes, and widespread practice does not guarantee success. A conceptual framework was then developed from a review of existing literature which was applied to analyse the perception and management of project risk within the HA. Four basic risk profiles or responses to a given level of risk were described namely:

- Risk Aversion
- Risk Tolerance
- Risk Neutrality
- Risk Seeking

From the results of the analyses performed in this study, the administered questionnaire and interviews with seven project sponsors and key staff of the HA, this study hereby attempts to classify the HA as a *risk tolerant* organisation. This varies from the classical academic view of public organisations as being very risk averse. The agency demonstrates all of the identified characteristics of risk tolerance which are re-stated below.

- Reasonably comfortable with most uncertainty
- Accepts uncertainty as a normal feature of everyday life
- Uncertainty has no significant influence on behaviour
- May fail to appreciate the potential effect of risk on the achievement of objectives

This has implications for the successful implementation of the ongoing change management programme to radically review processes, governance structures and capabilities in estimating, risk management, procurement, and delivery. Some institutional factors that were found to be linked with the risk profile of the organisation as a whole include the *awareness of risk, the incentive of project sponsors to manage risk, risk communication, culture and organisational learning.* These have already been

discussed. An in-depth analysis of these factors is beyond the scope of this study but the HA is advised to consider the limitations that these factors could impose on the success of its change management programme. Also at a national level the reward system in the public sector is generally perceived as being g*eared to reward not failing as opposed to succeeding spectacularly*. Except the HA is able to innovate and modify this perception among its project management staff it is unlikely that it would record the full benefits of the recommended improvements.

6.2.2 Statistical analyses reveal high variance in percentage cost creep on individual schemes during both planning and construction stages. This was surprising more so as schemes with creep values greater than +50% or -50% of PEC and MAB had been excluded from the analyses. Mean creep values were 4.95% during stage 1 and 1.955 during stage 2. Standard deviations of creep values were however 21.39 and 15.88. Significance statistics were consistently high for the following analysed relationships (Creep-MAB, Creep-Type of Scheme, and Creep-Type of Procurement). From Fig 4.7 it can be observed that the number of schemes with positive creep values is almost equal to the number of schemes with negative values. The reasons could not be ascertained as the HA does not have an efficient system for recording change events but they could be due to procurement route, project duration or changes in scope during construction. Changes in scope would have serious implications for the value to be derived from the built asset as large cost overruns on individual projects could be concealed by reduction in scope. The Nichols report has already raise concerns that the HA are getting less value from scheme delivery than already forecast. (Nichols, 2007:4).

6.2.3 The Nichols report has recommended that the TPI should be replaced with three groupings of schemes corresponding to three phases in their life cycle. (Nichols, 2007:i)

- Requirement definition (responsibility of DfT)
- Development (responsibility of HA)
- Construction (responsibility of HA)

Nichols recommended that the first phase should be funded from a resource budget; the second with individual scheme budgets covering cost to get to the next phase; and the last fully funded through to completion. This study is of the view that implementing this recommendation would provide opportunities for a programme management approach during stages the first two stages. Presently the schemes are managed by 14 area teams that cover the whole of England. The overall effect would be improved communication, improved resource management, better project prioritisation, and better management of risk across interrelated projects.

6.3 Recommendations

- Within the HA there are long serving and experienced staff who possess a wealth of knowledge. It is imperative for the HA to adapt its systems to capture, share, reuse and maintain the knowledge possessed by its people. Individuals within the organisation as well as the organisation as a whole are thus able to learn.

- It is recommended that the HA should implement a uniform project information management system for use by its consultants, contractors and suppliers to create, manage, store and retrieve project information. This would help it greatly in the future to obtain project information for use in range estimating and probabilistic scheduling. The present arrangement whereby project managers are tasked with the responsibility of retrieving project information from various sources when it is needed is not efficient.

- The Nichols report has recommended that the TPI should be replaced by three groups of schemes corresponding to three phases in their life cycle namely Requirements Definition, Development, and Construction. In order to ensure continuity of information flow throughout the life cycle of projects, it is recommended that the HA should adopt a programme management approach to all TPI schemes during the first two phases. This would replace the present arrangement where projects are discrete packages spatially located in 14 area teams. The use of programme management would also facilitate the sharing of knowledge between specialisms and across project boundaries.

- It is recommended that the agency should exercise care in the use of short term contracts with the goal of attracting adequately skilled project managers on flexible terms that present employment conditions do not support. The use of short term contracts would present problems of discontinuity of teams within projects and between projects. If knowledge is allowed to be move as people move between projects or between contracts there would be a dearth of knowledge available for future situations. The HA should innovate within existing civil service provisions to improve on staff recruitment, motivation and retention.

- Individuals and groups of people are primary engines of learning support and learning is best carried out through interaction of individuals and networks of people who may not be in the same part of an organisation but have the same work interests. It is recommended that the HA should facilitate more interaction between project managers who may be located in different areas teams to enable them share knowledge about their specialisms and project involvements.

6.4 Future Research

Further research is required to carefully examine the high occurrences of cost underruns during the construction stage of projects. The relatively low value of mean creep during the construction stage was found to be as a result of the balancing effect that projects with negative creep have on those with positive creep values. Negative creep values could be as a result of procurement route, project duration or change in scope during construction. Change in scope would have serious implications for the value to be derived from the built asset as large cost overruns on individual projects could be concealed by reduction in scope.

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Internet Address: www.highways.gov.uk (Official website of the Highways Agency)

Appendix 1

Questionnaire

Analysis of Organisational Perception of Risk in the Delivery of Major Road Projects in the United kingdom: A Case Study of the Highways Agency

MSc Thesis Questionnaire
The Bartlett, University College London

Thank you for taking the time to complete this questionnaire which is part of an MSc thesis in Project and Enterprise Management at the University College London. The objectives of the study are to assess the perception of project risk by the Highways Agency, to identify and review institutional sources and causes of bias, and to evaluate the influence of bias in the management of risk.

You would require about 15 minutes completing the questions. A summary would be prepared from the responses which would preserve anonymity of the respondents. The Highways Agency would receive a copy of the final report.

Some of the questions require that you compare the Highways Agency with similar organisations. When answering these questions, please benchmark the risk profile of the Highways Agency with similar organisations where you may have worked previously. If this is your first job please answer the questions by comparing the Highways Agency's risk management with what you expected to find when you joined newly.

If you are happy to help with this study I would telephone you on appointment to take your answers. You may however return the completed questionnaire to me by email or fax within the next 10 days at the address below.

Thank you very much for your help.

Yours sincerely,

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Analysis of Organisational Perception of Risk in the Delivery of Major Road Projects in the United Kingdom: A Case Study of the Highways Agency (HA)

			√
1	For how long have you been employed at the HA?	0 – 5 years	
		6 -10 years	
		Over 10 years	
2	For how long have you been a Project Sponsor/Manager in the HA?	0 – 5 years	
		6 -10 years	
		Over 10 years	
3	How many major road projects have you been involved with as a Project Sponsor/Manager in the HA?	0 – 10	
		11 – 20	
		Over 20	
4	Compared to similar organizations to what extent would you say that project risk management is deployed in the HA?	Less than average	
		More than average	
5	How regularly is the risk management process reviewed and improved?	Not regularly	
		Regularly	
6	To what extent is the effective management of risk perceived to be critical to project success?	Not to a large extent	
		To a large extent	
7	Does the level of perceived risk affect the actual resources allocated to projects?	Not a lot	
		A lot	
8	How much consideration is given to the identification of risk at the early stages of project planning?	Not a lot	
		A lot	
9	How much consideration is given to mitigating risk during project delivery?	Not a lot	
		A lot	
10	Within the HA how important is it that initial cost estimates be prepared as accurately as possible?	Not a lot	
		A lot	
11	To what extent could individual project managers be penalized for:		
a	Inaccurate cost estimates during the early stages of project planning	Not a lot	
		A lot	
b	Cost and time slippage during project delivery	Not a lot	
		A lot	
12	Compared to other organisations how much control do you feel you have over factors that affect the delivery of road projects to time and cost?	Less than average	
		More than average	
13	Project managers within the HA are personally accountable for:		
a	Identification of all possible risks during the early stages of project planning	Not a lot	
		A lot	
b	Effectively mitigating risks during project delivery	Not a lot	

		A lot	
14	Within the HA project managers are assessed based on the overall performance of projects in their portfolio.	Not True	
		True	
15	How much consideration does the HA give to the ability of project managers to identify and manage project risk effectively during:		
a	Recruitment	Not a lot	
		A lot	
b	Induction	Not a lot	
		A lot	
c	Retention	Not a lot	
		A lot	
d	Training	Not a lot	
		A lot	
e	Appraisal	Not a lot	
		A lot	
f	Reward and recognition	Not a lot	
		A lot	
16	The HA has extensive documentation on its preferred approach/attitude to risk management?	Not True	
		True	
17	How well are these values followed in practice?	Not a lot	
		A lot	
18	Compared to similar organisations how would you describe the role played by top management in the risk management process?	Less than average	
		More than average	
19a	There are different interest groups within the HA with regards to risk management?	Not true	
		True	
19b	If true, to what extents are differences resolved when they occur between the interest groups?	Not a lot	
		A lot	
19c	Among the interest groups some people have more power/influence than others	Not True	
		True	
20	To what extent do you feel the HA actively promotes pro-active risk management so as to deliver projects to time and budget?	Not a lot	
		A lot	
21	How does compliance with governance rules and regulations affect the effectiveness of project risk management within the HA?	Positively	
		No Effect	
		Negatively	
22	How does the HAs risk management process affect your ability to manage project risk?	Positively	
		No Effect	
		Negatively	
23a	To what extent are corporate policies communicated to project management staff within the HA?	Not a large extent	
		A large extent	
23b	To what extent are project managers able to act on these policies?	Not a large extent	
		A large extent	
24	Compared to similar organizations to what extent do you feel project staff work together/cooperate to realize project objectives?	Less than average	
		More than average	

25a	Compared to similar organizations to what extent do project management staffs share knowledge learned on projects?	Less than average	
		More than average	
25b	From your experience how useful has such shared knowledge been?	Not very useful	
		Very useful	
26	There are individuals within the HA who are responsible for promoting robust risk management?	Not true	
		True	
27	How well would you say the HA measures the success of project risk management?	Not very well	
		Very well	
28	In your view how much has the HA learned from its successes and its failures in the past?	Not a lot	
		A lot	
29	Compared to similar organizations to what extent does the HA seek and implement good practices from other organizations?	Less than average	
		More than average	
30	How would you describe project risk management within the HA?	Best in class	
		Very Good	
		Good	
		Developing	
		Poor	
31	Compared to similar organizations how much training and learning programmes in risk management does the HA provide for project managers?	Less than average	
		More than average	

Please give additional comments on the following:

1. What are your biggest concerns when developing initial cost estimates?

2. Please give your suggestions on how to improve on developing project cost estimates in the HA?

Completed by:

Job Title/Role:

Telephone:

Email:

Contact Address:

Thank you very much for your help.

Yours sincerely,

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Appendix 2

Fig 3.1 Stages of Scheme Development

Table 4.1 All TPI Project Data

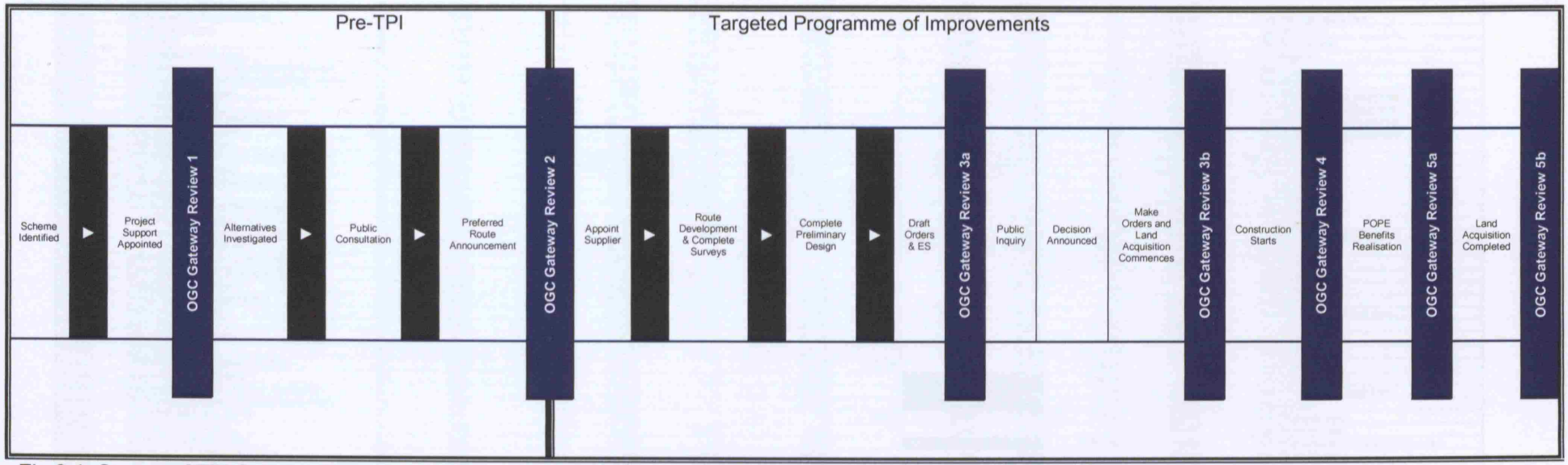

Fig 3.1 Stages of TPI Scheme Development (Adapted from Nichols, 2007:Appendix 2)

A	B	C	D	E	F	G	H	I	J	K	L	M	N
TPI No	Project Name	Type of Scheme (Widening-W, Bypass-B, Junction-J)	Procurement Type (D&B - Design and Build, DBFO - Design Build Transfer Operate, ECI - Early Contractor Involvement)	TPI Entry Cost (£000)	Programme entry cost adjusted to include inflation and non-recoverable VAT (£000)	Programme entry cost adjusted to include inflation, non-recoverable VAT and contingency - optimism bias (£000)	Programme entry cost adjusted for different approach to estimating (£000)	Ministerially Approved Budget (£000)	Outturn Cost (£000)	Date of TPI Entry	Date of Award	Actual Completion Date	Location
TPI 01	A1 Willowburn-Denwick Improvement (DBFO)	W	D&B	7,100	8,350	9,130	-	8,000	8,980	NA	Mar-01	Mar-03	North East
TPI 02	A1(M) Ferrybridge - Hook Moor (DBFO)	W	DBFO	160,000	160,000	160,000	-	160,000	160,000	Jul-98	Feb-03	Jan-06	North East
TPI 03	A1(M) Wetherby - Walshford (DBFO)	W	DBFO	49,900	59,980	62,690	-	83,000	83,000	Jul-98	Feb-03	Aug-05	North East
TPI 04	A2 Bean - Cobham Phase 1 Bean - Tollgate	W	D&B	43,800	55,540	60,360	-	21,000	22,890	Jul-98	Dec-02	Dec-04	London & South East
TPI 07	A5 Nesscliffe Bypass	B	D&B	13,480	16,120	17,590	-	3,000	20,180	NA	Dec-01	Mar-03	Midlands
TPI 08	A5 Weeford - Fazeley Improvement	B	ECI	30,580	37,800	42,830	-	41,000	40,990	Jul-98	Apr-03	Oct-05	Midlands
TPI 09	A6 Great Glen Bypass	B	D&B	16,790	19,440	20,350	-	9,000	20,890	NA	Apr-01	Feb-03	Midlands
TPI 010	A6 Rushden & Higham Ferrers Bypass	B	D&B	11,600	13,160	14,400	-	23,000	15,680	NA	Feb-02	Aug-03	East
TPI 011	A6 Rothwell - Desborough Bypass	B	D&B	10,730	12,550	13,720	-	18,000	18,960	NA	Feb-02	Aug-03	Midlands & East
TPI 012	A6 Clapham Bypass	B	D&B	31,000	34,220	37,640	-	22,000	43,900	NA	Mar-01	Dec-02	East
TPI 013	A6 Alvaston	B	D&B	13,080	15,490	16,900	-	25,000	22,300	NA	Jul-02	Dec-03	Midlands
TPI 014	A10 Wadesmill Colliers End	B	D&B	24,360	29,840	39,120	-	41,000	40,160	NA	Feb-02	Oct-04	East
TPI 015	A11 Roudham Heath -Attleborough Improvement	W	D&B	26,900	32,040	42,420	-	33,000	50,160	NA	Mar-01	Mar-03	East
TPI 016	A14 Rookery Crossroads Grade Separated Junction	J	D&B	5,000	5,970	6,700	-	10,000	13,400	Jul-98	Aug-04	Mar-06	East
TPI 017	A21 Lamberhurst Bypass	B	D&B	11,500	13,990	18,380	-	20,000	25,510	NA	Mar-03	Mar-05	London and Southeast
TPI 019	A27 Polegate Bypass	B	D&B	25,700	31,250	32,650	-	25,000	28,930	NA	May-00	Jun-02	London and Southeast
TPI 020	A34 Chieveley/M4 J13 Improvement	J	D&B	36,400	44,510	58,360	-	72,000	72,300	NA	Mar-03	Sep-04	London and Southeast
TPI 021	A41 Aston Clinton Bypass	B	D&B	21,300	25,170	33,320	-	54,000	44,350	NA	Mar-01	Oct-03	London and Southeast
TPI 022	A43 Silverstone Bypass	B	D&B	51,360	62,780	82,520	-	75,000	113,070	NA	Nov-00	Sep-02	East
TPI 023	*A43 Whitfield Turn -Brackley Hatch Improvement*	*W*	*D&B*	*Incl above*	*Incl above*	*Incl above*	-	*Incl above*	*Incl above*	NA	*Incl above*	*Incl above*	*Incl above*
TPI 024	*A43 M40 -B4031 Dualling*	*W*	*D&B*	*Incl above*	*Incl above*	*Incl above*	-	*Incl above*	*Incl above*	NA	*Incl above*	*Incl above*	*Incl above*
TPI 025	A46 Newark - Lincoln Improvement	W	D&B	30,000	35,980	39,240	-	39,000	40,730	NA	Oct-01	Jul-03	Midlands
TPI 026	A63 Selby Bypass	B	D&B	40,700	52,860	68,480	-	74,000	66,120	NA	Mar-01	Jun-04	North East
TPI 027	A66 Stainburn & Great Clifton Bypass	B	D&B	9,600	11,560	12,090	-	5,000	14,470	NA	Feb-01	Dec-02	North West
TPI 028	A120 Stansted - Braintree Improvement	W	D&B	91,800	112,440	117,480	-	78,000	104,580	NA	Jun-01	Jul-04	East
TPI 029	A249 Iwade - Queenborough Improvement	W	DBFO	79,000	79,000	79,000	-	81,000	81,000	Jul-98	Feb-04	Jul-06	London and Southeast
TPI 031[1]	A421 Great Barford Bypass	B	ECI	25,000	-	-	37,000	58,000	59,645	Jul-98	Apr-04	Aug-06	East
TPI 032[1]	A500 City Road & Stoke Junction Improvement	J	ECI	24,000	-	-	34,000	55,000	61,502	Jul-98	May-01	May-06	Midlands
TPI 033	A500 Basford, Hough, Shavington Bypass	B	D&B	28,010	33,450	44,190	-	53,000	54,300	NA	Mar-01	Mar-03	North West
TPI 034	A650 Bingley Relief Road	B	D&B	58,440	70,130	92,630	-	87,000	90,700	NA	NA	Dec-03	North East
TPI 035	A1033 Hedon Road Improvement	W	D&B	57,700	70,890	80,330	-	63,000	85,440	NA	Feb-01	Nov-03	North East
TPI 036	M25 J12-15 Widening	W	D&B	94,000	109,160	118,590	-	127,000	116,670	NA	May-03	Nov-05	London & South East
TPI 037	M60 J5-8 Widening	W	D&B	82,000	111,000	120,000	-	116,000	126,000	NA	Mar-03	Jun-06	North West
TPI 038[1]	A11 Attleborough Bypass	W	ECI	14,000		26,250	24,000	29,000	29,132	Mar-00	Feb-03	Feb-07	East
TPI 040	A47 Thorney Bypass	B	D&B	14,950	20,200	22,700	-	28,000	24,960	Mar-00	Aug-04	Dec-05	East
TPI 042[1]	A63 Melton Grade Separated Junction	J	D&B	11,000	-	16,815	16,000	22,480	26,410	Oct-00	Mar-04	Oct-06	North East
TPI 050	A30 Bodmin Indian Queens	W	ECI	49,000	-	92,108	-	[redacted]	[redacted]	Mar-01	Jul-02	Jul-07	South West
TPI 059	M40/A404 Handy Cross Junction Improvement	J	ECI	10,000	-	12,646	-	[redacted]	[redacted]	NA	Jun-03	Mar-07	London & South East
TPI 063	A428 Caxton Common to Hardwick Improvement	W	D&B	22,000	-	47,544	-	[redacted]	[redacted]	Aug-02	Apr-04	May-07	East
TPI 064[1]	A30/A382 Merrymeet Junction	J	ECI	7,000	-	-	12,000	12,000	12,330	Oct-02	Sep-03	Dec-06	South West
TPI 066	A1 Stannington Junction	J	D&B	5,600	6,640	7,570	-	9,000	7,240	NA	Mar-03	Oct-04	North East
TPI 068	A419 Commonhead Junction	J	ECI	12,000	-	17,614	-	[redacted]	[redacted]	Dec-02	Jul-03	Feb-07	Southwest, London & Southeast
TPI 069	M4 Junction 18 Eastbound Diverge	B	ECI	10,130	9,950	10,840	-	11,000	9,250		Apr-04	Nov-05	South West
TPI 070	M5 Junctions 17 - 18a Northbound Climbing Lane (Hallen Hill)	W	ECI	6,320	6,430	7,020	-	9,000	6,920	Dec-02	Apr-04	Oct-05	South West
TPI 071	M5 Junctions 19 - 20 Southbound Climbing Lane (Naish Hill)	W	ECI	9,000	9,000	11,000	-	12,000	10,000	Dec-02	Apr-04	Jun-06	South West
TPI 072	M5 Junctions 19 - 20 Northbound Climbing Lane (Tickenham Hill)	W	ECI	6,000	6,000	8,000	-	16,000	17,000	Dec-02	Apr-04	Jun-06	South West
TPI 087	A64 Colton Lane GSJ	J	D&B	11,320	10,690	11,320	-	8,000	12,400	NA	Jan-04	Jun-05	North East

NOTES

1. Schemes that entered the programme prior to April 2003 for which initial Ministerially Approved Budget and Outturn Cost have been suppressed

NA - Data not available

Appendix 3

Table 4.2 Calculation of Creep Values (PEC-MAB)

Table 4.3 Reduced Project Data (PEC)

Table 4.3A Reduced Project Data (MAB)

Table 4.2 Calculation of Creep Values: PEC - MAB

A	B	C	D = C-B	E = (D/B)*100	F	G	H	I	J = I - H	K
TPI No	PEC: Programme entry cost adjusted to include inflation, non-recoverable VAT and contingency - optimism bias (£m)	MAB: Ministerially Approved Budget (£m)	Variance (£m)	% Creep: PEC-MAB	Type of Scheme (Widening-W, Bypass-B, Junction-J)	Procurement Type (D&B - Design & Build, DBFO - Design Build Transfer Operate, ECI - Early Contractor Involvement)	Date of Award	Actual Completion Date	Project Duration (Months)	Location
TPI 01	9.13	8.00	-1.13	-12	W	D&B	Mar-01	Mar-03	25	
TPI 02	160.00	160.00	0.00	0	W	DBFO	Feb-03	Jan-06	36	
TPI 03	62.69	83.00	20.31	32	W	DBFO	Feb-03	Aug-05	30	
TPI 04	60.36	21.00	-39.36	-65	W	D&B	Dec-02	Dec-04	25	
TPI 07	17.59	3.00	-14.59	-83	B	D&B	Dec-01	Mar-03	28	
TPI 08	42.83	41.00	-1.83	-4	B	ECI	Apr-03	Oct-05	31	
TPI 09	20.35	9.00	-11.35	-56	B	D&B	Apr-01	Feb-03	23	
TPI 010	14.40	23.00	8.60	60	B	D&B	Feb-02	Aug-03	19	
TPI 011	13.72	18.00	4.28	31	B	D&B	Feb-02	Aug-03	19	
TPI 012	37.64	22.00	-15.64	-42	B	D&B	Mar-01	Dec-02	22	
TPI 013	16.90	25.00	8.10	48	B	D&B	Jul-02	Dec-03	18	
TPI 014	39.12	41.00	1.88	5	B	D&B	Feb-02	Oct-04	33	
TPI 015	42.42	33.00	-9.42	-22	W	D&B	Mar-01	Mar-03	25	
TPI 016	6.70	10.00	3.30	49	J	D&B	Aug-04	Mar-06	20	
TPI 017	18.38	20.00	1.62	9	B	D&B	Mar-03	Mar-05	25	
TPI 019	32.65	25.00	-7.65	-23	B	D&B	May-00	Jun-02	26	
TPI 020	58.36	72.00	13.64	23	J	D&B	Mar-03	Sep-04	19	
TPI 021	33.32	54.00	20.68	62	B	D&B	Mar-01	Oct-03	32	
TPI 022	82.52	75.00	-7.52	-9	B	D&B	Nov-00	Sep-02	23	
TPI 025	39.24	39.00	-0.24	-1	W	D&B	Oct-01	Jul-03	22	
TPI 026	68.48	74.00	5.52	8	B	D&B	Mar-01	Jun-04	40	
TPI 027	12.09	5.00	-7.09	-59	B	D&B	Feb-01	Dec-02	23	
TPI 028	117.48	78.00	-39.48	-34	W	D&B	Jun-01	Jul-04	38	
TPI 029	79.00	81.00	2.00	3	W	DBFO	Feb-04	Jul-06	30	
TPI 031	37.00	58.00	21.00	57	B	ECI	Apr-04	Aug-06	29	
TPI 032	34.00	55.00	21.00	62	J	ECI	May-01	May-06	61	
TPI 033	44.19	53.00	8.81	20	B	D&B	Mar-01	Mar-03	25	
TPI 034	92.63	87.00	-5.63	-6	B	D&B	NA	Dec-03	NA	
TPI 035	80.33	63.00	-17.33	-22	W	D&B	Feb-01	Nov-03	22	
TPI 036	118.59	127.00	8.41	7	W	D&B	May-03	Nov-05	31	
TPI 037	120.00	116.00	-4.00	-3	W	D&B	Mar-03	Jun-06	40	
TPI 038	26.25	29.00	2.75	10	W	ECI	Feb-03	Feb-07	49	
TPI 040	22.70	28.00	5.30	23	B	D&B	Aug-04	Dec-05	17	
TPI 042	16.82	22.48	5.67	34	J	D&B	Mar-04	Oct-06	32	
TPI 050	[redacted]		0.89	1	W	ECI	Jul-02	Jul-07	61	
TPI 059	[redacted]		0.35	3	J	ECI	Jun-03	Mar-07	46	
TPI 063	[redacted]		7.46	16	W	D&B	Apr-04	May-07	38	
TPI 064	12.00	12.00	0.00	0	J	ECI	Sep-03	Dec-06	40	
TPI 066	7.57	9.00	1.43	19	J	D&B	Mar-03	Oct-04	19	
TPI 068	[redacted]		-1.61	-9	J	ECI	Jul-03	Feb-07	44	
TPI 069	10.84	11.00	0.16	1	B	ECI	Apr-04	Nov-05	19	
TPI 070	7.02	9.00	1.98	28	W	ECI	Apr-04	Oct-05	18	
TPI 071	11.00	12.00	1.00	9	W	ECI	Apr-04	Jun-06	27	
TPI 072	8.00	16.00	8.00	100	W	ECI	Apr-04	Jun-06	27	
TPI 087	11.32	8.00	-3.32	-29	J	D&B	Jan-04	Jun-05	17	
Note										
[redacted]	PEC and MAB have been suppressed									

Table 4.3 Reduced Project Data PEC

TPINo	PEC	MAB	CREEP	DOA	DURATION	STYPE	LOCATION	PROCUREMENT
TPI 01	9.13	8.00	-12	01-Mar-2001	25	1	1	1
TPI 02	160.00	160.00	0	01-Feb-2003	36	1	1	2
TPI 03	62.69	83.00	32	01-Feb-2003	30	1	1	2
TPI 04	60.36	21.00	#NULL!	01-Dec-2002	25	1	4	1
TPI 07	17.59	3.00	#NULL!	01-Dec-2001	28	2	3	1
TPI 08	42.83	41.00	-4	01-Apr-2003	31	2	3	3
TPI 09	20.35	9.00	#NULL!	01-Apr-2001	23	2	3	1
TPI 010	14.40	23.00	#NULL!	01-Feb-2002	19	2	2	1
TPI 011	13.72	18.00	31	01-Feb-2002	19	2	8	1
TPI 012	37.64	22.00	-42	01-Mar-2001	22	2	2	1
TPI 013	16.90	25.00	48	01-Jul-2002	18	2	3	1
TPI 014	39.12	41.00	5	01-Feb-2002	33	2	2	1
TPI 015	42.42	33.00	-22	01-Mar-2001	25	1	2	1
TPI 016	6.70	10.00	49	01-Aug-2004	20	3	2	1
TPI 017	18.38	20.00	9	01-Mar-2003	25	2	4	1
TPI 019	32.65	25.00	-23	01-May-2000	26	2	4	1
TPI 020	58.36	72.00	23	01-Mar-2003	19	3	4	1
TPI 021	33.32	54.00	#NULL!	01-Mar-2001	32	2	4	1
TPI 022	82.52	75.00	-9	01-Nov-2000	23	2	2	1
TPI 025	39.24	39.00	-1	01-Oct-2001	22	1	3	1
TPI 026	68.48	74.00	8	01-Mar-2001	40	2	1	1
TPI 027	12.09	5.00	#NULL!	01-Feb-2001	23	2	5	1
TPI 028	117.48	78.00	-34	01-Jun-2001	38	1	2	1
TPI 029	79.00	81.00	3	01-Feb-2004	30	1	4	2
TPI 031	37.00	58.00	#NULL!	01-Apr-2004	29	2	2	3
TPI 032	34.00	55.00	#NULL!	01-May-2001	61	3	3	3
TPI 033	44.19	53.00	20	01-Mar-2001	25	2	5	2
TPI 034	92.63	87.00	-6	#NULL!	#NULL!	2	1	2
TPI 035	80.33	63.00	-22	01-Feb-2001	22	1	1	2
TPI 036	118.59	127.00	7	01-May-2003	31	1	4	2
TPI 037	120.00	116.00	-3	01-Mar-2003	40	1	5	2
TPI 038	26.25	29.00	10	01-Feb-2003	49	1	2	3
TPI 040	22.70	28.00	23	01-Aug-2004	17	2	2	2
TPI 042	16.82	22.48	34	01-Mar-2004	32	3	1	2
TPI 050	92	[redacted]	1	01-Jul-2002	61	1	6	3
TPI 059	13	[redacted]	3	01-Jun-2003	46	3	4	3
TPI 063	48	[redacted]	16	01-Apr-2004	38	1	2	2
TPI 064	12	12.00	0	01-Sep-2003	40	3	6	3
TPI 066	8	9.00	19	01-Mar-2003	19	3	1	2
TPI 068	18	[redacted]	-9	01-Jul-2003	44	3	7	3
TPI 069	10.84	11.00	1	01-Apr-2004	19	2	6	3
TPI 070	7.02	9.00	28	01-Apr-2004	18	1	6	3
TPI 071	11.00	12.00	9	01-Apr-2004	27	1	6	3
TPI 072	8.00	16.00	#NULL!	01-Apr-2004	27	1	6	3
TPI 087	11.32	8.00	-29	01-Jan-2004	17	3	1	1
Note								
[redacted]	MAB has been suppressed							

Table 4.3A Reduced Project Data MAB

TPINo	MAB	OUTTURN	CREEP	DOA	DURATION	STYPE	LOCATION	PROCUREMENT
TPI 01	8.00	8.98	12	3	25	1	1	1
TPI 02	160.00	160.00	0	7	36	1	1	2
TPI 03	83.00	83.00	0	7	30	1	1	2
TPI 04	21.00	22.89	9	6	25	1	4	1
TPI 07	3.00	20.18	#NULL!	4	28	2	3	1
TPI 08	41.00	40.99	0	7	31	2	3	3
TPI 09	9.00	20.89	#NULL!	3	23	2	3	1
TPI 010	23.00	15.68	-32	5	19	2	2	1
TPI 011	18.00	18.96	5	5	19	2	8	1
TPI 012	22.00	43.90	#NULL!	3	22	2	2	1
TPI 013	25.00	22.30	-11	6	18	2	3	1
TPI 014	41.00	40.16	-2	5	33	2	2	1
TPI 015	33.00	50.16	#NULL!	3	25	1	2	1
TPI 016	10.00	13.40	34	10	20	3	2	1
TPI 017	20.00	25.51	28	7	25	2	4	1
TPI 019	25.00	28.93	16	1	26	2	4	1
TPI 020	72.00	72.30	0	7	19	3	4	1
TPI 021	54.00	44.35	-18	3	32	2	4	1
TPI 022	75.00	113.07	#NULL!	2	23	2	2	1
TPI 025	39.00	40.73	4	4	22	1	3	1
TPI 026	74.00	66.12	-11	3	40	2	1	1
TPI 027	5.00	14.47	#NULL!	3	23	2	5	1
TPI 028	78.00	104.56	34	3	38	1	2	1
TPI 029	81.00	81.00	0	9	30	1	4	2
TPI 031	58.00	59.65	3	9	29	2	2	3
TPI 032	55.00	61.50	12	3	61	3	3	3
TPI 033	53.00	54.30	2	3	25	2	5	1
TPI 034	87.00	90.70	4	#NULL!	#NULL!	2	1	1
TPI 035	63.00	85.44	36	3	22	1	1	1
TPI 036	127.00	116.67	-8	7	31	1	4	1
TPI 037	116.00	126.00	9	7	40	1	5	1
TPI 038	29.00	29.13	0	7	49	1	2	3
TPI 040	28.00	24.96	-11	10	17	2	2	1
TPI 042	22.48	26.41	17	9	32	3	1	1
TPI 050			-7	6	61	1	6	3
TPI 059			25	7	46	3	4	3
TPI 063			-3	9	38	1	2	1
TPI 064	12.00	12.33	3	8	40	3	6	3
TPI 066	9.00	7.24	-20	7	19	3	1	1
TPI 068			-6	8	44	3	7	3
TPI 069	11.00	9.25	-16	9	19	2	6	3
TPI 070	9.00	6.92	-23	9	18	1	6	3
TPI 071	12.00	10.00	-17	9	27	1	6	3
TPI 072	16.00	17.00	6	9	27	1	6	3
TPI 087	8.00	12.40	#NULL!	9	17	3	1	1
Note								
	MAB and OUTTURN have been suppressed							